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LOGAIR AND QUICKTRANS:
A MODEL IN COMBINATION

THESIS

Thomas J. Bruns, Captain, USAF

AFIT/GLM/LSM/90S-7

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LOGAIR AND QUICKTRANS:
A MODEL IN COMBINATION

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

Thomas J. Bruns, B.S.
Captain, USAF

September 1990

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Thomas J. Bruns

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Abstract

With impending reductions in military personnel strengths and imminent defense budget cuts it is imperative that economies of operation be explored within the defense arena. This research focused on whether merging the LOGAIR and QUICKTRANS systems improves operations and reduces costs. Similarities and differences between LOGAIR and QUICKTRANS systems were explored in the following areas: production process, cost structure, procedural structure, and managerial structure. Additionally, a Spacefilling Curve algorithm was used to establish a route model for the QUICKTRANS, LOGAIR, and combined system to determine cost/benefits.

The research concluded that there appeared to be no significant impediments to merging the LOGAIR and QUICKTRANS systems into a single combined system. Both systems are historically linked to providing priority movement of spares in support of the services first-line weapon systems within the Defense Transportation System and are commonly governed by DOD Directive 4500.32R, Military Standard Transportation and Movement Procedures. Any unique operating characteristics are not impediments to merging as evidenced by the existing common route structure, LOGAIR 5Q, in Florida. Finally, the author's combined routing model indicates that there are sufficient opportunities for

rationalization and inherent capacity excesses, in both systems, to realize over 30 million dollars savings per year.

LOGAIR AND QUICKTRANS: A MODEL IN COMBINATION

I. Introduction

Overview

On November 13th, 1989 Secretary of Defense Richard B. Cheney ordered the services to draft plans for \$180 billion in spending cuts from 1992 through 1994 (Willis, 1989:3). It is becoming more apparent that with the sweeping reforms in the communist block countries and automatic deficit reducing programs the military system will need to "support and defend" with less. With impending reductions in military personnel strength and imminent defense budget cuts it is imperative that economies of operation be explored within the defense arena. One such area of possible economy is being explored by HQ MAC/TRP. Their focus is on merging the two contracted Continental United States (CONUS) based cargo airlift systems, LOGAIR and QUICKTRANS, into one single system (Quirk, 1989:1-2). HQ MAC/TRP expects several benefits from consolidation of the QUICKTRANS and LOGAIR systems, these include: operating efficiencies; reduced duplicate routes; and general economies of scale (Quirk, 1989:1).

In many instances the terms "efficiencies", "utilization", "performance" and "productivity" are used interchangeably when discussing transportation or

distribution systems (Tyworth, 1987:444-445). However, the cited HQ MAC/TRP benefit of "improved efficiencies" is better characterized by improved productivity of a consolidated LOGAIR and QUICKTRANS system. Productivity is defined as the ratio of real output produced to real resources consumed. The measure of this performance improvement is commonly associated with ton-miles transported divided by the total actual transportation cost (Tyworth, 1987:445). The measurement ton-miles is the product of total freight tons hauled multiplied by the total distance traveled (Coyle, 1986:513).

HQ MAC/TRP's cited benefit of reduced duplicate routes with a consolidated system is not strongly supportable. However, a related benefit of reducing shared or common locations is much more plausible. Currently the LOGAIR system has approximately sixty locations from which cargo originates and is delivered while the QUICKTRANS system has approximately 30 locations. The two systems have eight common locations. Although, neither LOGAIR nor QUICKTRANS share facilities at these common locations the potential for shared use exists.

HQ MAC/TRP's cited benefit of achieving general economies of scale has mixed reviews. Economies of scale are said to occur when a system becomes larger and the output, in this case, cargo moved increases, the average cost per unit of output decreases because each succeeding unit consumes a lesser portion of the fixed costs (Chase, 1989:274).

Intuitively, this appears what would happen to a combined LOGAIR and QUICKTRANS system. However, Chase also warns of systems that because of their increased size, suffer from increased costs of staffing and increased costs of providing adequate coordination of material or cargo flow (Chase, 1989:275). Additionally, Jordon examined a total of 24 airline mergers that occurred between 1985 and 1987. He concluded that initially after a merger the newly combined system experienced increased costs per revenue ton-mile. It was not until the combined or newly merge system eliminated duplicate route structures and combined facilities at common terminals that average operating expenses dropped below the industry average (Jordon, 1988:26-27).

Background

LOGAIR. LOGAIR is an Air Force contracted logistics cargo airlift system managed by the Air Force Logistics Command (AFLC). The LOGAIR system consists of a series of cargo hubs (Hub and Spoke system) strategically located at each Air Logistic Center (ALC) within the CONUS. Each cargo hub is connected by a series of airlift routes that provide the movement of cargo to the hubs, enroute locations, and Military Airlift Command (MAC) Aerial Port of Embarkations (APOEs) for delivery and pickup of additional cargo (See Figure 1). The primary objectives of the LOGAIR system are:

1. Provide a dedicated Air Force managed and controlled airlift system in the Contiguous United States.
2. Improve readiness support by providing daily logistic airlift to our major weapon system bases within CONUS and to

overseas activities through an effective interface with Military Airlift Command (MAC) international airlift system.

3. Reduce the number of spares required to maintain operational capability, by shortening the shipment time of Air Force items in the Defense Transportation System (DTS).

4. Improve the quality and reliability of the Air Force Logistics System through the increased use of aircraft and compatible ground support equipment. (AFR 76-1, 1990:20)

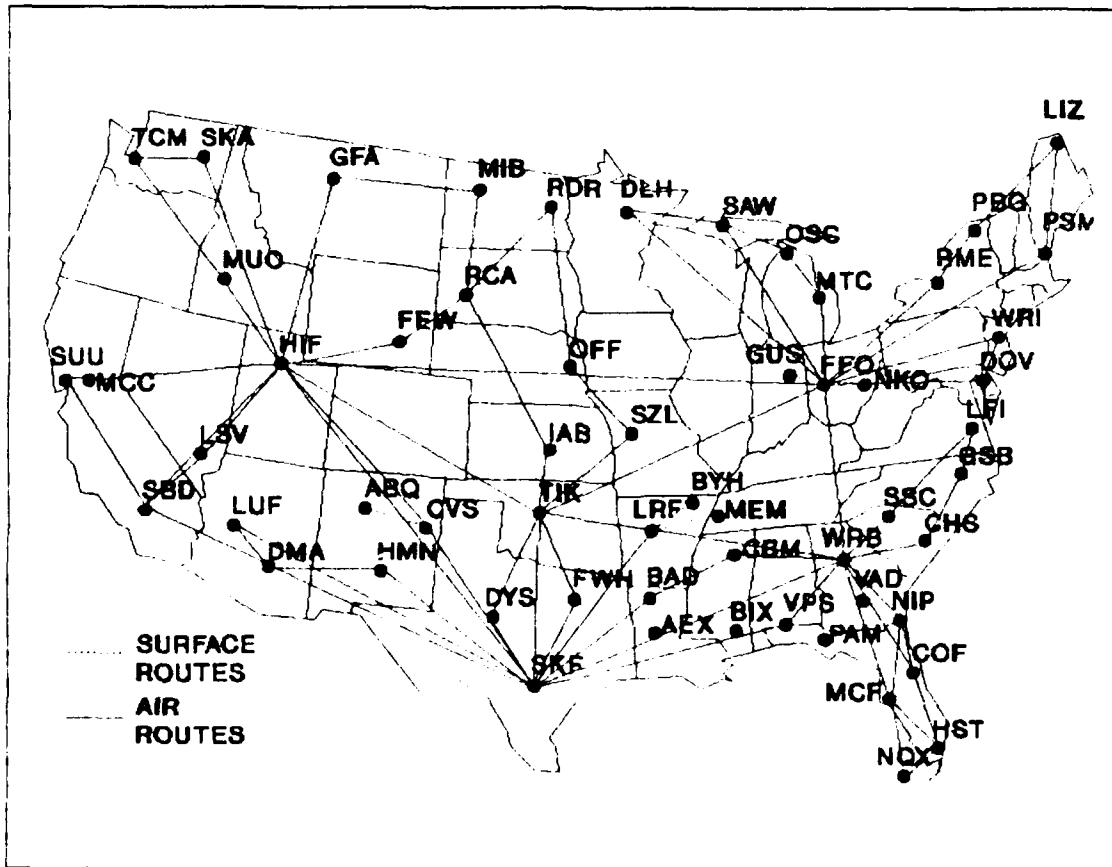


Figure 1: LOGAIR FY 90 route structure. Effective 1 October 1990.

The LOGAIR system was created in 1954 when it became clear that there was a need for a dedicated air transport system to support domestic Air Force weapon system in preparation for "D-day" (national emergencies) (Kipp, 1956:8). Originally coined the "Mercury Service" the LOGAIR system became a reality 5 February 1954 (Kipp, 1956:17).

The dedicated system was the preferred method of transport since, in 1954, there was not a dependable peacetime commercial air cargo carrier or carriers that had the capability to provide the service needed (Kipp, 1956:v-vi).

QUICKTRANS. QUICKTRANS is an Air Force contracted (airlift services) and Navy contracted (terminal services) logistics cargo airlift system managed by the Navy Material Transportation Office (NAVMTO) (Customer's Guide, 1984:6 and Navy, 1990:5). The QUICKTRANS system consists of two cargo routing systems, one on each coast. This system provides rapid movement of material between Naval Air Stations, U.S. Navy ships, MAC aerial ports, aircraft engine overhaul and repair facilities, major Navy shipyards, major supply activities, nuclear propulsion development and fabrication facilities, and weapon system fabrication and testing facilities (See Figure 2) (Hamann, 1983:9-10). The Mission of QUICKTRANS system is to move cargo via airlift and truck service in order to provide a controlled, flexible, and responsive method of expediting urgently required cargo between points of major Navy interest within the CONUS (Navy, 1990:5). The primary objectives of the QUICKTRANS system are:

1. Optimize the utilization of QUICKTRANS within CONUS to provide a single effective and efficient system for transporting high priority Navy material which directly or indirectly supports the fleet. This includes providing the lift capability for the CONUS segment shipments moving via the Military Airlift Command to overseas destinations.

2. Operate QUICKTRANS as a segment of the DOD Transportation System under the direction and control of NAVSUP.

3. Develop and guide the peacetime employment of the QUICKTRANS Airfreight System in a manner that will enhance emergency and wartime Navy and Marine Corps transportation, achieve greater flexibility and mobility of material and equipment, and increase logistics effectiveness and economy. (NAVSUP INST, 1988:1).

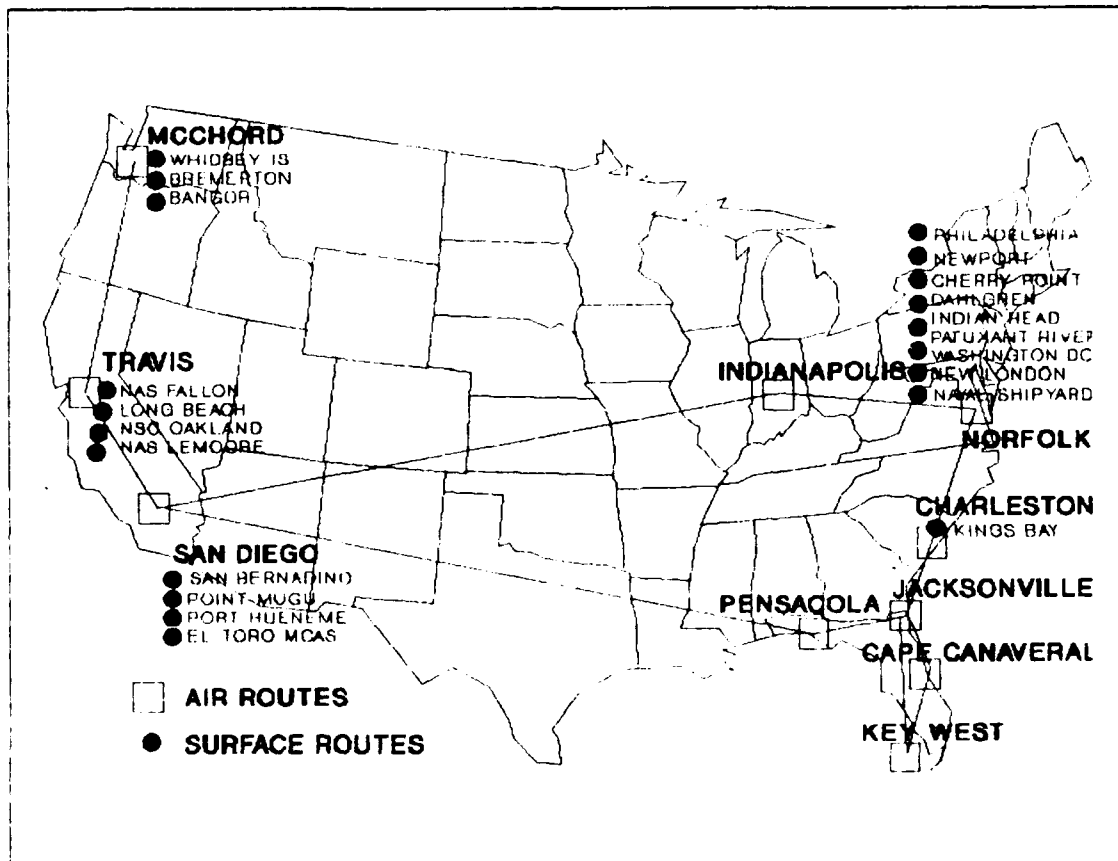


Figure 2: QUICKTRANS FY90 route structure. Effective 1 June 1990.

The Navy established the QUICKTRANS Contract Airlift Services in July, 1950, as a result of resupply crises during the Korean War. A clear need for a dedicated air transport system to improve transportation times and to achieve greater control, flexibility, and mobility of high priority Navy material and equipment was envisioned as the

best solution. The dedicated air transport system was the preferred method of transport since, in 1950 there was not a dependable peacetime commercial air carrier that could provide the service required (Coon, 1986:20-21).

Systems Comparison. Although both LOGAIR and QUICKTRANS main objectives, the priority movement of spares in support of the services' weapon systems, are similar, their route structures are significantly different. LOGAIR is comprised of approximately 60 locations fairly evenly dispersed across the United States (See Figure 1). On the other hand, the approximately 30 QUICKTRANS locations are densely situated on either the east or west coast (See Figure 2). The dispersed LOGAIR system would seem to favor an aircraft-oriented system while the denser QUICKTRANS system would seem to favor a truck-oriented system to satisfy the priority movement of cargo.

Additionally, the LOGAIR system uses a smorgasbord of different cargo aircraft including the L100, B-727, DC-9, L-188, and the CV640. This provides the LOGAIR system the capability to tailor the aircraft used to provide the type and range of aircraft service required. The QUICKTRANS system utilizes only the L-100 aircraft. The greatest benefit using only the L-100 is that it provides the largest cargo carrying versatility and capacity from small cargo to large aircraft engines.

Finally, all LOGAIR system locations or destinations are operated and manned by Air Force personnel. QUICKTRANS has

opted to contract the terminal services for the aircraft transport services. The QUICKTRANS terminal services may take some of the flexibility out of scheduling cargo movement since it must be coordinated and negotiated as part of the service contract. On the other hand, the terminal service contract may be a less expensive alternative to the LOGAIR system which maintains the entire personnel force and facilities internally.

Previous Research Efforts. The purpose of this section is to provide a review or summary of the accomplished research efforts on the QUICKTRANS and LOGAIR systems. In this manner the author hopes to avoid duplicating other research efforts.

In 1961 Huff and others researched the concept of high speed transportation (air) and the effects on critical cargo movement within the Department of Defense (DOD). This research focused on the responsiveness and economy of cargo movement. One of the main conclusions of this research effort was that the contract air transportation systems, LOGAIR and QUICKTRANS, should be consolidated into a single DOD system and placed under the management of the Single Manager for Airlift Service (MAC) (Huff, 1961:1-19).

On 30 July 1974 the Office of Assistant Secretary of Defense (OASD) tasked the Secretary of the Air Force to develop a proposal for a responsive, efficient, and consolidated (all services) contract airlift service. The contract airlift service was to be designed to be at least

as efficient and as cost effective as the then current LOGAIR and QUICKTRANS systems. The result of the study proposed a consolidated systems which made MAC the operations manager while AFLC and the Navy split the responsibility for logistics management. Because of the Navy's nonconcurrence with the proposal and the fact both LOGAIR and QUICKTRANS had "demonstrated successful efforts to eliminate duplication of CONUS airlift services", implementation of the proposal was held in abeyance awaiting further data collection (Secretary of the Air Force, 1975:1-4). No further information could be located on this subject.

In 1975 Melton designed a "FORTRAN" computer model called the QUICKTRANS Economic Simulation and Tabulation (QUEST) model. The system was designed to forecast the QUICKTRANS system costs and logistics parameters including load factors and vehicle utilization. The author concluded that, by using QUEST, an analyst may predict the efficiency of potential route patterns (Melton, 1975:1-12).

The following year, Melton provided a follow-on computer model called QUICKTRANS Airlift Model (QUAM). QUAM was designed to forecast the system's cost, vehicle utilization, and route/schedule load factors for proposed routes. Again the author concluded that by using QUAM a proposed system route pattern efficiency may be predicted (Melton, 1976:1-11).

Palmatier and Prescott, in 1975, developed a computer model to determine an optimal LOGAIR route structure. The model developed was a mixed integer distribution algorithm. The algorithm was not able to reach an optimal solution, however it was able to provide a route structure that totaled less mileage than the then current LOGAIR structure (Palmatier, 1975:1-6, 42-44).

McPherson and O'Hara provided follow-on research to Palmatier and Prescott in 1976. The authors utilized a mixed-integer branch-and-bound algorithm to improve the previous LOGAIR route structure. The final routes were compared against the existing routes used by AFLC during FY 75 and FY 76. The authors concluded that the computer method is a useful tool for developing route structures and recommended adoption by AFLC (McPherson, 1976:1-20, 36-38).

Also in 1976, Moberly and Gorychka designed a mathematical model which reduced pipeline times incurred by cargo moving through the LOGAIR system. However, the model did not select the best flight combination needed to move the cargo. Nor did it account for statistical fluctuation of daily cargo movement requirements and therefore only accounted for average cargo tonnages. The model was deemed useful by the authors, for planning and evaluating the existing LOGAIR route structure (Moberly, 1976:1-6, 46-49).

Bourdreaux and Olansen in 1977 developed a mathematical model that devised and tested methods of minimizing LOGAIR feeder route transportation costs. The LOGAIR system, in

1977, was completely airlift oriented with no provisions for surface transportation. The authors concluded that the introduction of surface vehicles along with the relaxation of certain performance measurements Uniform Material Movement and Issue Priority System (UMMIPS) would result in significant costs savings for the Air Force (Bourdreaux, 1977:1-8, 38-56).

In 1979 Valkenburgh concluded a study focusing on the use of airlift to improve the readiness of combat forces. The study merged the LOGAIR concept with the single hub concept of the Federal Express Corporation. The author concluded that a single hub concept reduced the cargo transit times significantly. However, along with the reduction of transit time there was a noticeable increase in the overall cost of the route structure (Valkenburgh, 1979:1-9, 67-69).

Like the Valkenburgh study, Payne and Scott examined the feasibility of a single hub concept for LOGAIR in 1980. The authors concluded that a single hub system would provide next day delivery of practically all cargo within the system. However, operating costs rose by 19.6 percent. The authors reasoned that the increased operating costs would be more than offset by money saved with an anticipated reduced inventory (Payne, 1980:1-6, 51-54).

In 1981 Magowan and Richardson analyzed the historical data of one LOGAIR route attempting to find an accurate and reliable avenue of forecasting base level airlift requirements. The methodology the authors chose involved

relatively uncomplicated and easy to use statistical tools. They concluded that there was little correlation between most variables examined and the best forecast was obtained by using the simple moving average (Magowan, 1981:38-45).

The Logistics Management Institute (LMI) completed an evaluation of the Air Force LOGAIR system in 1981. The report was in response to an Office of the Secretary of Defense (OSD) request earlier in the year. The major conclusion of the report indicated that the LOGAIR system needed to be improved to meet existing DOD time standards and make the system more competitive with alternative transportation modes. Recommendations included a more efficient network concept and enhancing the LOGAIR management information and control systems (Dienemann, 1981:1-8).

LMI also completed an evaluation of the QUICKTRANS system in 1981. The evaluation consisted of a direct comparison of the existing structure contrasted with commercial alternatives based on costs, transit time and overall effectiveness. LMI concluded that the QUICKTRANS system was efficiently operated and that the dedicated air and truck system should be "retained in its present form" (An Evaluation, 1981:1-9).

In 1983 Holden and Weber examined the development of the QUICKTRANS system and the concurrent growth of the commercial air cargo industry. The authors concluded that the commercial system represents an effective and cost

efficient alternative to QUICKTRANS. However, to implement a commercial air cargo system would necessarily require a complete revamping of the existing QUICKTRANS process and an all new way of thinking for the Navy relative to cargo transport (Holden, 1983:93-100).

Hamann reviewed the 1983 QUICKTRANS system with respect to cargo loss and damage. The author concluded the system is reasonably effective based on computerized material control and the way the system was designed to be implemented (Hamann, 1983:49-50).

In 1985 Garret and MacPherson completed an extensive study of the LOGAIR system in comparison to commercial air carriers. The study examined cargo movement data including frequency distributions for weight, volume, number of pieces, and priority of shipments. The study examined costs for shipments under the hundred pound limit rather than taking a linear average of hundred weight costs. The authors concluded that LOGAIR costs were competitive with commercial cargo carriers for similar services. The analysis also provided a foundation upon which to build a model for an Air Force CONUS freight shipment network (Garrett, 1985:1-22, 158-164).

A 1986 thesis by Coon contrasted the services provided by commercial air freight services, the QUICKTRANS system, and the Military Airlift Command (MAC). The author concluded from his research that the commercial sector offers significant improvements for transit time and shipment

traceability over that available from the both QUICKTRANS and MAC (Coon, 1986:87-90).

Justification of Research. The importance of the logistics support provided by the QUICKTRANS and LOGAIR systems can not be under-estimated primarily for two reasons. The first is the operational costs of maintaining the QUICKTRANS and LOGAIR systems during a period of shrinking defense budgets. The cost for operating the LOGAIR system for Fiscal Year (FY) 1989 was nearly 86 million dollars while the operational cost for operating the QUICKTRANS system for FY 89 was nearly 38 million dollars (QUICKTRANS, 1990:x and LOGAIR, 1990:x). With over 120 million defense dollars used to support the CONUS movement of high priority DOD cargo through these two contract airlift systems, the need for cost effective and efficient operations becomes more obvious.

The second important factor is the logistic support itself in providing a strong defense for the country. The movement of men and equipment to a battlefield adds value to those resources. Although neither LOGAIR and QUICKTRANS directly support movement directly to the battlefield, they are part of logistics system that supports movement of spares to ensure that the first-line weapon systems are prepared. Without effective transportation, those men and materials could not be par of the defensive action and would not be able to deter the enemy. In his book, *The Art of War*, Jomini provides the association between logistics,

tactics, and strategy. All three are important to success on the battlefield, favoring one area over the others has resulted in undeniable defeat (Jomini, 1958:120-140). Winston Churchill made a pointed comparison to the role of logistics when he said "Victory is the bright-colored flower. Transport is the stem without which it could never have blossomed." (Churchill, 1899:viii).

Combining the LOGAIR and QUICKTRANS system may result in a potential larger and more efficient cargo movement system. A cursory review of both systems already indicates eight common locations. Additionally, the LOGAIR 5Q route provides cargo service to both Navy and Air Force components along the Florida peninsula. Both systems provide cargo movement to either coast, however the QUICKTRANS must fly virtually non-stop from coast to coast since they have no intermediate locations. The diverse infrastructure of the LOGAIR system may have existing capacity to move Navy cargo coast-to-coast thus avoiding the long-haul QUICKTRANS movement.

Research Objective

The focus of this research or the research question for this study is: Would merging the LOGAIR and QUICKTRANS systems improve operations and reduce costs?

Investigative Questions

The following investigative questions will be used to answer the research question. The investigative questions are tailored to provide insight into the concept of whether

the merging both contract air cargo systems will provide the benefits desired. The ultimate benefits to be derived from a combined system would be improved productivity and reduced costs.

1. What are the similarities and differences between LOGAIR and QUICKTRANS:

A. In the production process (labor resources, material handling, facilities, and route structure).

B. In the cost structure (shipping rates and maintenance of aircraft).

C. In the procedural structure (cargo movement selection and method of routing cargo).

D. In the managerial structure (public law, DOD regulation, and service regulation).

2. What methods could be used to effectively combine the QUICKTRANS and LOGAIR systems?

3. What would be the costs/benefits of combining the QUICKTRANS and LOGAIR systems?

Scope of the Research

The limit of this research is bounded by the limitations of the LOGAIR and QUICKTRANS cargo systems. Both systems include surface transportation as part of the overall cargo service. Since it would be difficult to limit the analysis to only air eligible all cargo moved within either system will be used as part of the evaluation process. Ultimately the evaluation process will look at the total costs of the current and proposed systems based upon the number of miles the cargo was transported. The research will focus on developing a combined route structure model that optimizes the resources of both systems. The limits of the combined

route structure will be the physical and policy constraints residing internally within each system. These constraints will ensure that the model developed will provide realistic use of the combined resources and any benefits realized will be because of a combined system and not attributable to the efficiency of modeling the system.

Plan of Analysis

The entire thesis will cover five separate chapters. Each chapter has a specific objective in providing insight and understanding of the research question. Chapter 2 is a review of the literature covering; the policy and procedures of the QUICKTRANS and LOGAIR system; hub and spoke efficiencies; and routing and location theory. This chapter will provide the reader with the necessary background to understand the methodology of formulating the combined cargo route structure. Chapter 3 explains the methodology in determining the combined route structure. Additionally, this chapter will detail the rule based procedures for answering the investigative questions. Chapter 4 will provide the results and analysis of the research effort. Finally, the research findings, conclusions, and recommended actions are presented in Chapter 5.

II. Literature Review

Introduction

In order to understand and provide an insight into the investigative questions and ultimately the research question, a survey of literature was accomplished. The survey concentrated on five major areas: the policy and procedure of both systems, an examination of the route structures with a discussion of hub and spoke efficiencies, a review of location theory, an examination of routing theory, and a review of productivity measures. These specific areas will provide the background for devising the combined routing model presented in chapter 3.

Policy and Procedures

Authorizing Laws. A review of specific legal sources was unsuccessful in surfacing any specific laws or statutes that specifically authorize either the LOGAIR or QUICKTRANS systems. However, according to Mr Andy Figueroa Chief, Transportation Management Division, HQ AFLC, LOGAIR (and QUICKTRANS) are allowed to exist by interpretation through their funding in the Defense Authorization and Appropriation Acts. Both systems are contained within the funding of Second Destination Transportation (SDT) and are not separate line items (Figueroa, 1990).

DOD Regulation. Both QUICKTRANS and LOGAIR fall within the purview of the DOD Directive 4500.32R, Military

Standard Transportation and Movement Procedures (MILSTAMP). MILSTAMP provides generalized guidelines for the movement of cargo within the Defense Transportation System (DTS). This regulation provides definitive performance standards for the movement of cargo dependent upon the transportation priority of the cargo. These standards are outlined under the Uniform Material Movement and Issue Priority System (UMMIPS) within the MILSTAMP regulation (DOD 4500.32, 1988:4-60). Both LOGAIR and QUICKTRANS are subject to and, in most cases, their performance is evaluated on, the ability to satisfy the applicable performance standards. Relative to QUICKTRANS and LOGAIR the four transportation priorities and their corresponding movement standards are listed below:

A. MICAP/999: must be moved by the transportation method that provides the earliest delivery to the customer (Dept of the Air Force AFR 75-1, 1989:Para 34-4).

B. Transportation Priority One (TP-1): must arrive within 3 days of shipment.

C. Transportation Priority Two (TP-2): must arrive within 6 days of shipment.

D. Transportation Priority Three (TP-3): must arrive within 13 days of shipment. (DOD 4500.32R, 1988:4-13)

Service Regulations. Besides the more generalized DOD regulation, both LOGAIR and QUICKTRANS operations are subject to individual service regulations. Specific guidance on LOGAIR operation is contained in AFR 76-1, Military Airlift and USAF LOGISTICS AIRLIFT (LOGAIR), while a more broad guidance for QUICKTRANS is contained in NAVSUP Instruction 4610.37A, QUICKTRANS Airfreight System.

AFR 76-1 provides explicit details of how and what cargo can be shipped within the LOGAIR system. Cargo to be moved within the LOGAIR system must be "air eligible". Air eligible cargo is any cargo that qualifies for one of the top three transportation priorities; MICAP/999, TP-1, and TP-2. In addition, TP-3 cargo is moved by LOGAIR to ensure high cargo load factors are achieved (Dept of the Air Force AFR 76-1, 1990:Para 5.3). All "air eligible" DOD cargo is authorized to move within the LOGAIR system. This authority is implied since the funding authority falls under the heading SDT in the Defense Authorization Acts, and is explicitly authorized by MILSTAMP since LOGAIR is a part of the Defense Transportation System (DTS) (DOD MILSTAMP, 1988:1-C-4). However, if the "air eligibility" of the cargo is unknown the airlift clearance authorization can be obtained through the LOGAIR air terminal manager or the Air Force Distribution and Control Office (AFDCO) located at Wright-Patterson AFB, OH (Dept of the Air Force AFR 76-1, 1990:Para 7-2 and 7-5). The purpose of the Airlift Clearance Authority (ACA) is to establish and control the entry or acceptance of "air eligible" cargo into the Defense Transportation System (DOD MILSTAMP, 1988:2-B-17). In addition, the Air Force Distribution and Control Office provides detailed tracking and tracing of all cargo within the LOGAIR system (Dept of the Air Force AFR 76-1, 1990, Chap 3).

Unlike the detailed procedures identified in the Air Force Regulation 76-1, the Navy's NAVSUPINST 4610.37A provides only generalized policy guidance. QUICKTRANS is afforded the flexibility for movement of "air eligible" cargo anywhere within the CONUS and nearby offshore areas when deemed "necessary for reason of national security". All Department of Defense cargo is eligible for movement within the QUICKTRANS system on a reimbursable basis (Dept of the Navy, 1988:1-3). Airlift clearance authority for the Navy is provided by Navy Material Transportation Office (NAVMTO), Code 031 (Bryan, 1990). Additionally, NAVMTO provides detailed tracking and tracing of cargo within the QUICKTRANS system (Customer's Guide, 1984:4-5). According to Mr Bob Warren, QUICKTRANS Contracting Officer and Technical Representative (Alt), the ability to provide accurate and timely tracking and tracing of QUICKTRANS cargo is very important to the management of the system, and is required by the customers (Warren, 1990).

Although the QUICKTRANS and LOGAIR systems are separate systems attending the basic high priority cargo requirements of different services, there are several commonalities. Both QUICKTRANS and LOGAIR derive their basic policy and procedures from the Department of Defense Directive 4500.32R (MILSTAMP). Additionally, both systems are funded by the Defense Authorization and Appropriation Acts, not as separate line item, i.e. QUICKTRANS or LOGAIR, but under the broader line item heading as Second Destination

Transportation. Further, as implied by their funding origins, both are an inseparable part of Defense Transportation System.

Cost Structure. Both LOGAIR and QUICKTRANS provide cargo movement on a reimbursable basis. The Navy provides monthly computation of a rate structure that will provide reimbursement to the Navy Management Fund by QUICKTRANS users (Dept of the Navy, 1988:3). The Air Force possesses a similar system. However, the LOGAIR system provides a tariff structure, annually, that indicates cost per pound between the Air Logistic Centers, MAC Aerial Ports of Embarkation, and other selected LOGAIR points (Dept of A.F. AFR 76-1, 1990:Chap 1). Additionally, the LOGAIR rate charge is based on a density factor often pounds per cubic foot. This means that anything weighing less than ten pounds but larger than one cubic foot is charged an applicable rate of ten pounds per cubic foot (Wiese, 1990).

Aircraft maintenance costs, for both LOGAIR and QUICKTRANS, are satisfied by the owner of the aircraft. Therefore the actual cost of maintenance is satisfied as part of the Navy's and Air Force's payment to the contractor for cargo moved. Additionally, the contractor is paid based on the number of Great Circle Statute Miles (GCSM) the aircraft travels and not the amount of cargo moved. However, the contractor is required to guarantee a minimum amount of cargo tonnage for each contracted aircraft type (MAC Contract, 90:B-1).

Finally, the aircraft terminals are contracted by the Navy in support of the QUICKTRANS system. Therefore, those costs are separable from the other Navy operational costs (Naval Supply, 90:5-10). The LOGAIR air terminal costs are a separable cost of the system, but are not a factor in formulating the LOGAIR tariff rates. The approximately 25 million dollars, per year, expended for terminal operations are derived from SDT Operations and Maintenance (O&M) sources (Figueroa, 1990 and Wiese, 1990).

Route Structures

The discussion of the LOGAIR and QUICKTRANS route structures (Chapter 1) would be incomplete without a discussion of the effectiveness of the hub and spoke system. Both systems use the hub and spoke, to a degree, for movement of the cargo within their systems.

Hub and Spoke. The most significant development in the airline industry is thought to be the establishment of the hub and spoke route networks (Kahn, 1988:318 and Toh, 1985:16). The hub and spoke radial pattern is similar to the hub and spoke pattern of a bicycle wheel (See Figure 3). The central location operates as the hub of the wheel with radial spokes connecting the outlying feeder locations. This pattern design consolidates aircraft flight operations at the hub to provide optimum traffic flow for all arriving and departing aircraft (Phillips, 1985:18). Toh found that there were at least the following operational efficiencies when using a hub and spoke network:

1. By acting as collection and dissemination points, hubs permit indirect connections between numerous city pairs that by themselves cannot generate enough traffic to justify direct flights.

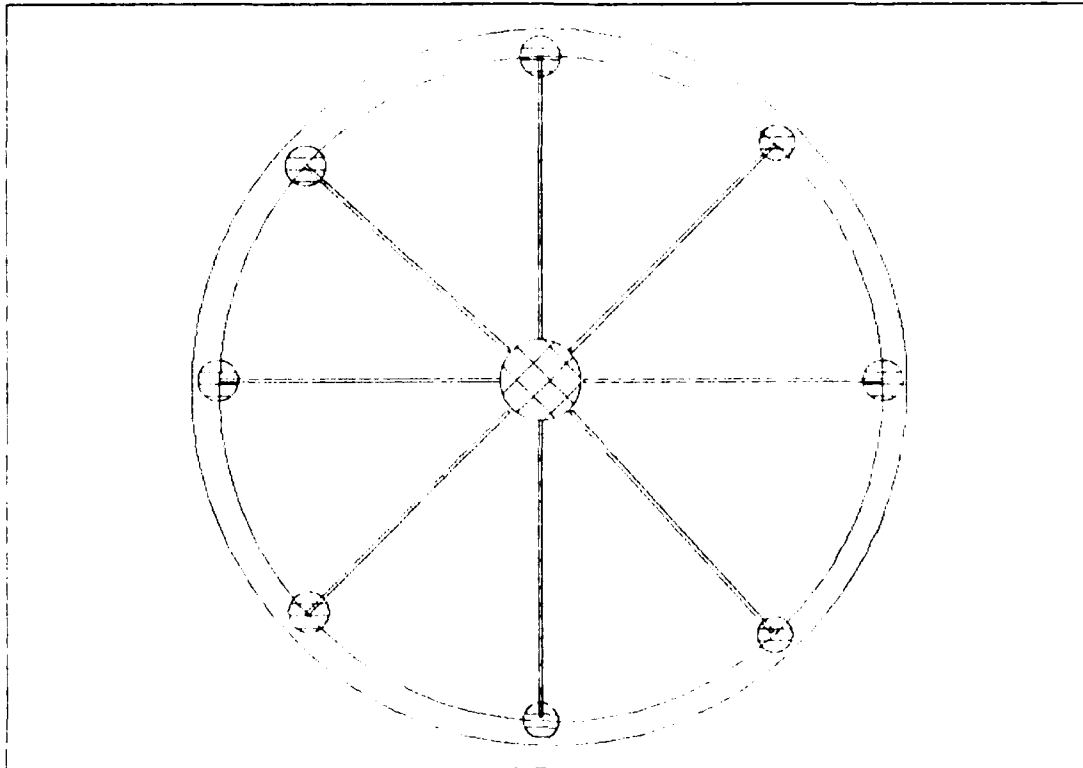


Figure 3: Hub and spoke radial network pattern.

2. A hub and spoke pattern allows all the operating stations to be served by a minimum of aircraft and flight sectors.

3. The shortness of the sectors allows for the use of smaller aircraft with greater frequency and therefore higher utilization rates.

4. Maintenance, servicing, and apron (ramp) services can be economically centralized at the hub city.

5. Aircraft arrivals and departures at the hub city can be judiciously synchronized so that passengers (or cargo) brought in from the outlying cities can be transferred to the airlines's other flights departing from the hub; thus a system of cross-feeder traffic is generated, effectively elevating load factors on all the airline's routes. (Toh, 1985:17)

One important aspect of hub and spoke efficiency is the centrality of the spoke. Centrality of the spoke refers to the number of enroute stops an aircraft makes prior to reaching or after leaving the hub. As an example, if an airlines's scheduled aircraft all have direct flights into and out of the hub, the hub's centrality is 1.0. But, if the airlines's scheduled aircraft all make one enroute stop prior to landing at the hub and make one enroute stop after leaving the hub, the hub's centrality is 2.0. Two separate studies, one by Toh and Higgins and one by Talley and Eckroade, found the more profitable the airlines the closer the centrality was to 1.0 (Talley, 1984:74 and Toh, 1985:22).

LOGAIR Route System. LOGAIR has been described as an extensive, high speed transportation network using a combination of air cargo and surface cargo modes to reduce inventory levels and to reduce pipeline times between supplier and user organizations. The design was precipitated by a need to ensure operational readiness of the U.S. Air Force's first-line weapon systems through rapid delivery of essential material (USAF, 1978:2). First-line weapon system include any weapon system that could be used as a primary means of defending United States resources. As a result, a good portion of Air Force cargo is classified as high-priority cargo by the UMMIPS (DOD MILSTAMP, 1988:Figure 2-B-1).

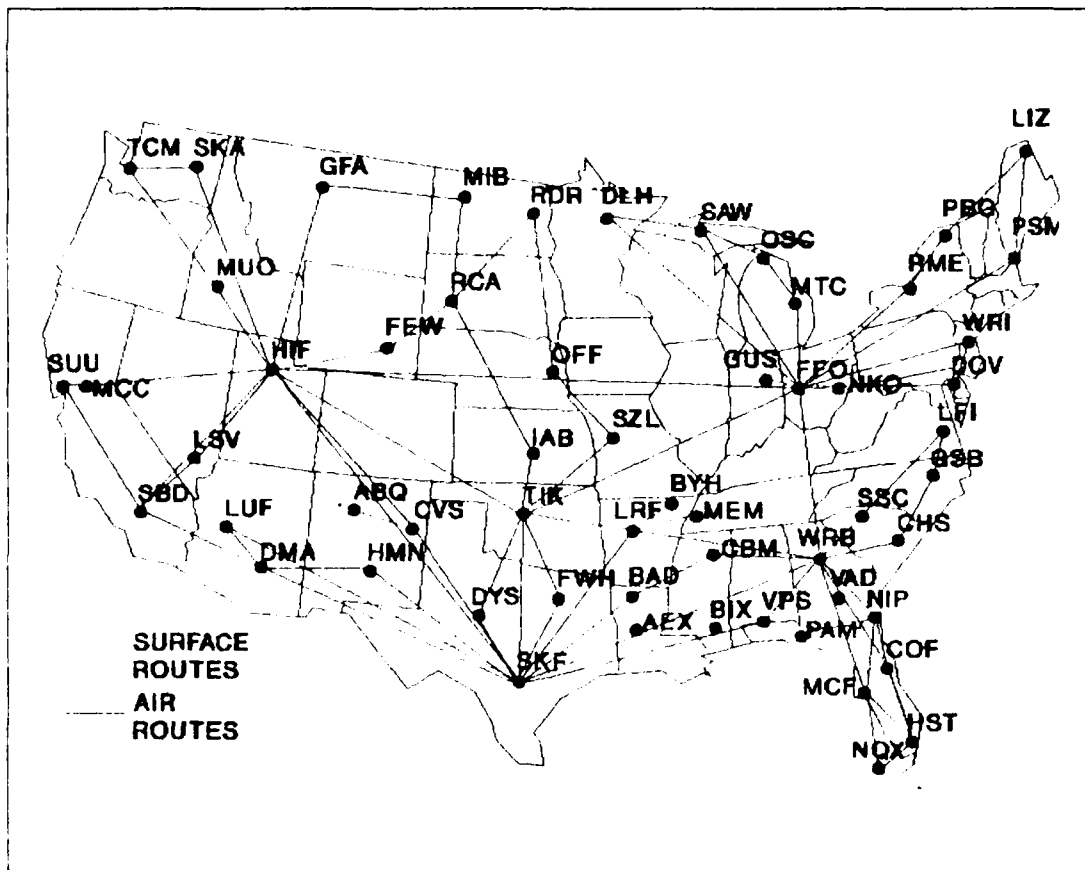


Figure 4: LOGAIR Route Structure, Effective 1 October 1989.

The LOGAIR route structure revolves primarily around the Air Force Logistics Command's (AFLC's) Air Logistic Centers (ALCs), including Wright-Patterson AFB, and CONUS MAC's Aerial Ports of Embarkation (APOE). The ALCs include: Sacramento ALC at McClellan AFB CA, Ogden ALC at Hill AFB UT, Oklahoma ALC at Tinker AFB OK, San Antonio ALC at Kelly AFB TX, and Warner Robins ALC at Robins AFB GA. The ALCs provide depot repair capabilities for many weapon systems and each is the location of large depot warehouses which supply many of spares required by the first-line weapon systems. The CONUS MAC APOEs are essential to the LOGAIR

structure since they serve as overseas air cargo ports supporting the first-line weapon systems located outside the CONUS.

Finally, the LOGAIR system consists of on-line routings and off-line routings. The on-line routings are the bases that included in the official route structure and are served directly by a LOGAIR flight or LOGAIR integrated truck (See Figure 4). The off-line routings are activities that are served by a LOGAIR station, but are not part of the LOGAIR route structure (United States, 1989:8).

QUICKTRANS Route System. The QUICKTRANS Airfreight System is a contractor operated, CONUS-wide system of cargo terminals, connected by a scheduled air service, connecting trucks, and an elaborate communications network. The Operations Control Center is located in Code 03 at Navy Material Transportation Office (NAVMTO) in Norfolk, Virginia (NAVMTO, 1984:2). Trucks are used to supplement the air transport system on both line haul and for short cargo movements prior or following to a scheduled air cargo transport. QUICKTRANS cargo scheduling is centrally managed from Norfolk (Navy data, 90). The system was designed to move cargo via airlift and truck service to provide a controlled, flexible, and responsive CONUS system for expediting required material for the Navy's first-line weapon systems (Naval Supply, 90:5).

The QUICKTRANS route structure revolves primarily around the Navy's aircraft engine overhaul and repair facilities,

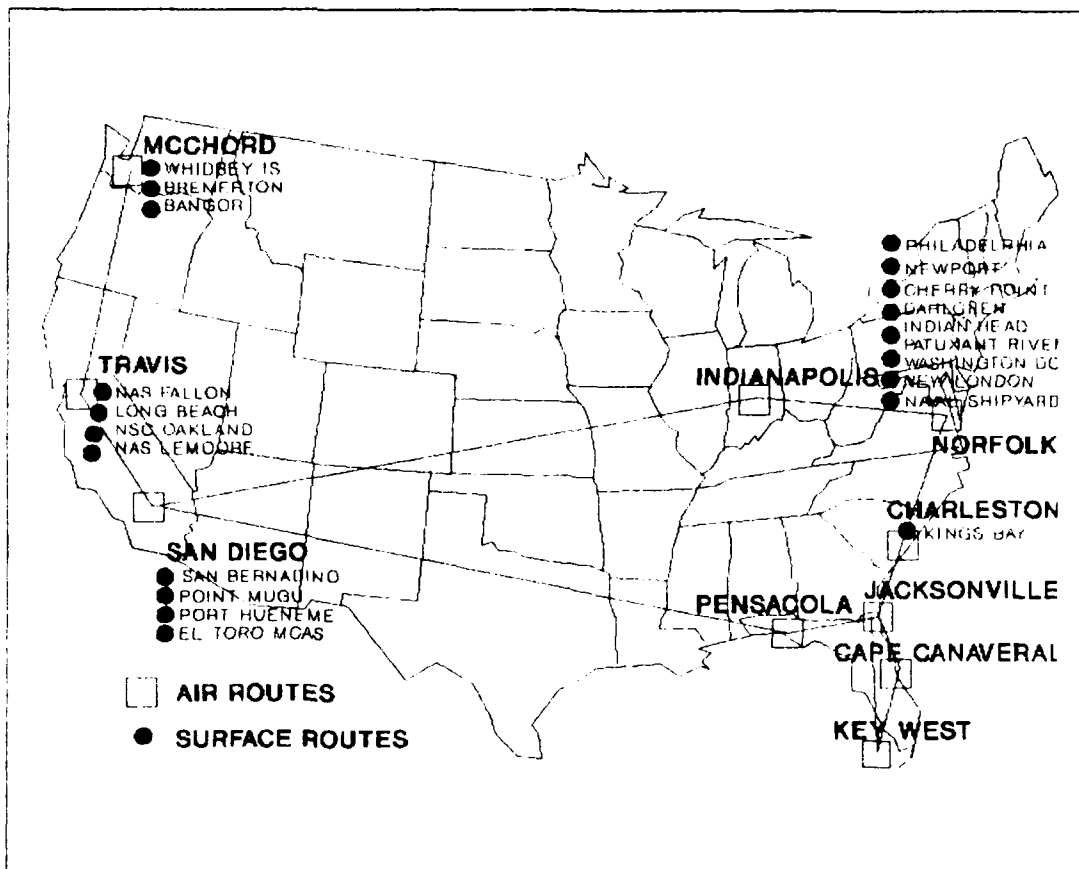


Figure 5: QUICKTRANS Route Structure, Effective 1 June 1990.

major supply activities, and several CONUS MAC APOE's (See Figure 5). The major hubs of the QUICKTRANS system provide depot overhaul capability along with large warehouses which provide many of the spares required by the Navy's first-line weapon systems.

Location Theory

One of the most important factors when considering a distribution system is where to locate facilities for distribution of goods. Costs such as transportation of raw materials and finished goods affect the profitability of

individual companies. Additionally, the time used to cover the distances between warehouses, or in the case of LOGAIR and QUICKTRANS, depots, affects inventory levels and the probability for stockouts. A survey of several location techniques and theories are presented for the reader.

One of the earliest location theories was presented by the German agriculturalist, Johann Henrich Von Thunen. Von Thunen simplified the "complexity" of the location problem by assuming an isolated city state was surrounded by a zone of equal fertility. All agricultural goods could be produced equally well in any portion of the zone. The isolated city was the only market for the harvest. Transportation was assumed equally accessible to all locations within the zone. Von Thunen's least cost theory focused on transportation costs as a determining factor on where individual agricultural products should be produced. Locations at a greater distance from the city would realize greater transportation costs. For low value and high weight goods it would not be profitable to produce these goods at the greater distances from the city because of the high transportation costs incurred. Additionally, perishable items, Von Thunen concluded, needed to be produced close to the city (market) to minimize transit time. Although Von Thunen's theory is of classical origin, much of what he theorized is still used today and represents the foundation of more contemporary research (Coyle, 1986:29-30).

Alfred Weber, a German economist, formulated a theory that focused on the location of industrial plants. Like Von Thunen, Weber defined the best location as the one yielding the least cost. The least cost location is defined as the location that minimizes the cost of moving raw materials to the plant and finished goods to the market. According to Weber, raw materials were classified by geographic availability and the weight lost in processing. The geographic availability classification implied that the raw material was either abundant, "ubiquitous", or found at certain locations, "localized". Raw materials which were ubiquitous or did not lose weight in processing allowed processing facilities to be located near the market. Raw materials that were localized or lost weight in processing required plant locations close to source of materials to minimize transportation costs (Coyle, 1986:30).

Edgar M. Hoover, an American theorist, developed a least cost approach to facility location that included the cost of transportation on the product and relative market demand for the product. Hoover's theory differed from Von Thunen's and Weber's in three major areas. First, Hoover recognized that transportation rates were not linear with distance. Transportation rates were shown to increase with distance, but not proportional to the relative distance. This nonlinearity of rates is called the tapering rate principle. Second, Hoover discovered that cargo carriers were not evenly dispersed or "homogenous" throughout the country. He

recognized that some locations had a greater density of potential cargo carriers thus affecting the competitive price structure. Third, Hoover pointed out that the importance of transportation costs varied with individual companies. Product characteristics and volume of shipments made the importance of transportation costs variable for each company (Coyle, 1986:31-33).

According to Chase and Aquilano, the objective in location selection is minimization of three classes of costs: regional costs, distribution costs, and raw material and supply costs. Regional costs include construction labor, land costs, and state and local expenses. Distribution costs are costs of shipping products to markets and other segments of the distribution system. Raw material and supply costs include production necessities such as water, energy, and production lead time (Chase, 1989:285). Additionally, Chase and Aquilano identify several techniques for determining facility locations; these include: factor-rating systems, detailed cost analysis, and center of gravity methods.

The factor-rating system is described as one of the most widely used of the general location techniques. Its popularity is attributed to its ability to combine dissimilar factors in an easily understood format. The technique yields a range of potential points for each preidentified factor. Each potential location is evaluated on these factors and points are assessed per factor and

location relative to all locations. The sums of assigned points for each location are compared and the location with the highest point value is selected. Critics of this methodology insist that factor-rating systems do not account for the wide range of costs that may occur within each factor (Chase, 1989:287).

The detailed cost analysis, as the name implies, compares actual costs for the predetermined factors for each proposed location. Cost factors that are normally compared include: transportation, labor, plant overhead, utilities, taxes, and workmen's compensation insurance. Usually present-value calculations are included for each factor resulting in a more detailed comparison (Chase, 1989:287-289).

A technique for determining a facility location that considers the existing market or nodal locations and the volume of goods required to be shipped is called the center of gravity method. Some literature referred to this technique as the grid technique. This method places existing locations on a coordinate grid system with the purpose of establishing relative distances between nodes. The center of gravity, ideal facility location, is found by calculating X and Y coordinates that will provide the least cost of transportation. The limitations to this method include: assumptions of linear transportation costs, solutions are static and must be reaccomplished with the introduction of new information, and topographic and

directional orientation of transportation modes are ignored (Chase, 1989:289-291).

Routing Methods

Once a distribution system facilities have been located, such as QUICKTRANS and LOGAIR terminals, a topic which comes to the forefront is how to effectively route cargo vehicles to efficiently interchange needed materials or services. Routing analysis normally considers routing of populations or cargo through an established transportation network, such as bus systems or airline networks. One of the best and comprehensive audits of contemporary routing methods and techniques was conducted by Chan and Rowell. Much of the presented routing methodologies was extracted from their comprehensive review, *Integrated Location-and-Routing Models Part I: A Review of Model Formulations*. In this review Chan says that basic routing problem can be stated as follows:

Given a set of nodes and/or arcs, construct a feasible set of routes to optimize some objective, such as minimizing the cost of travelling from origin m to destination n , allowing for the case where m and n are the same node. A feasible route may be required to visit a sequence of locations to provide a specific service at these locations. (Chan, 1990:13)

One of the simplest route models is the shortest route. The objective of this model is to find the shortest route from origin m to destination n in the shortest distance with m not equal to n . The final solution will yield a desired set of arcs which link m to n . A variation to this problem is where the length of arcs are time dependent. These

formulations are motivated by applications like "peak travel hours where it takes longer than off-peak travel" (Chan, 1990:13-14).

When the shortest path problem includes the destination, where $m=n=1$, this is called a traveling salesman problem (TSP). The objective of the traveling salesman problem is find the shortest route from origin through all locations and back to the origin. A variation of the TSP is the Multiple Traveling Salesman Problem (MTSP). The MTSP uses more than one tour to cover all nodes using the origin as a depot. In this manner all nodes are visited based on the number of tours, salesmen, that are required (Chan, 1990:14-15).

When delivery requirements (cargo) are inserted at the demand nodes of the TSP, the problem becomes a Vehicle Routing Problem (VRP). The objective of the VRP is to find the route or routes, dependent on the number of vehicles, from the origin through all nodes and returning to the origin. The problem provides for limitations such as: vehicle capacity, nodal service limited to one vehicle, and time constraints on the length of each tour. The final solution yields a set of arcs linking the origin and to a set of nodes. These solution arcs are the least-cost tours available (Chan, 1990:15-17).

The minimal-spanning tree problem attempts to find a way to reach all nodes in a network from a particular node, the origin, in a manner that the total length of all branches

(arcs) used is minimal. This differs from the classical Traveling Salesman Problem which seeks to visit all locations and return to the origin resulting in the shortest tour length. A variation to the minimal-spanning tree problem, the Chinese Postman Problem (CPP), attempts to determine the minimal cost tours which pass through every node, at least once, in the network. Variations include a vehicle capacity limitation which Chan indicated could be transformed into a Vehicle Routing Problem (Chan, 1990:17-20).

By placing time window constraints on the Traveling Salesman Problem it is transformed into a Time Constrained Traveling Salesman Problem (TCTSP). The ultimate objective remains to find the shortest route from origin through all locations and back to the origin. However, now some locations are limited to operating times that they can be visited (Chan, 1990:21-22). This problem adds a note of realism to a routing problem since many operations do not operate 24 hours per day.

The complexity of these routing problems becomes considerable if parameters such as multiple origins and deterministic or probalistic demand characteristics are added. Deterministic factors infer that they are by nature static or constant. These factors can be relied upon not to change and can be accurately scheduled. Distances between locations are deterministic. Probalistic factors infer that they are by nature ever changing. These factors may be

difficult to forecast with great accuracy. In many cases averages of the factors are used and some attempt is made to measure the range by which it varies. LOGAIR and QUICKTRANS cargo demands are probabilistic factors.

As part of Chan's conclusions, he states:

When the combined location/routing models include time windows, tour/route length, and other realistic routing considerations the formulations (mathematical algorithms) becomes prohibitively complex. (Chan, 1990:33).

One alternative he suggests for the "prohibitively complex" problems is the use of heuristic approximation techniques. In his opinion, most appear to perform quite well for operational needs (Chan, 1990:33).

As an example of the power of heuristics to arrive at good operational answers for Traveling Salesman Problems, Chan cites the 1989 research effort of Merrill. Merrill was able to execute a Spacefilling Curve (SFC) heuristic for a Probabilistic Multiple Traveling Salesman Facility Location Problem (PMTSFLP) for 75 cities using up to 4 aircraft (Chan, 1990:9-10). In his thesis, Merrill concluded that the Spacefilling Curve would arrive at solutions that were within 25% of the optimal Traveling Salesman Problem solution. Merrill's actual results were within 10% of optimum and required only 1% of the computer time required by more conventional means (Merrill, 1989:75).

LOGAIR Routing Method. The current LOGAIR route structure is a result of two studies accomplished at Southern Methodist University and sponsored by the Air Force

Office of Scientific Research. The research resulted in an optimization model that uses mathematical programming, network theory, and distribution statistics to arrive at the least cost set of cargo routes which satisfy the point-to-point cargo demands (Kennington, 1981:1-10). The Air Force Logistics Command, Transportation Directorate has implemented the modeling system as the DO65 process of "Logistics Air Lift Computer Model."

Routing of cargo is performed by an optimization model and expert system designed specifically for Air Force Cargo. This system is called ALLOCATE. ALLOCATE is comprehensive computer-based system for allocating cargo pallets to aircraft (Nygard, 1989:1). The system was installed for daily use at Wright-Patterson AFB, OH in 1989.

The "heart" of the system is an automatic allocator that combines a highly structured generalized assignment optimization model called ASSIGN and an expert system named REVISE (Nygard, 1989:1). The entire cargo allocation process is characterized by the following decision factors:

1. Pallets are categorized into high, medium and low priority classes.
2. Often there are several alternative flights to which particular pallets can be assigned.
3. Pallets are of 2 basic sizes, with one large pallet being equal in length to a small pallet, but having twice the width.
4. Pallets of the same size are often clamped together to form inline pallets used to transport long items.
5. The system has a choice of three aircraft types: L-100, L-188, and DC-9. Each aircraft differs in capability.

6. There are always many more pallets available than can possibly be allocated. As a result, low priority pallets are often diverted to surface transportation, and some pallets must wait and be allocated on a later day.

7. Each aircraft type has geometric layout and loading limitations.

8. Pallets may hold hazardous cargo that is categorized into 29 possible types. Incompatible types cannot be allocated to the same aircraft, some types are allowed to land only at authorized stations, and there are weight limits by hazardous type that apply to both aircraft and to certain stations.

9. There are circumstances under which cargo is allowed to be shipped to an intermediate station rather than a final station (Nygard, 1989:4).

The system maximizes the number of high priority pallets allocated, followed by medium and low priority pallets. If alternative ways exist to allocate the same pallets in a priority sequence, a secondary goal of minimizing total pallet-miles applies (Nygard, 1989:3).

The two goals, maximize priority pallets and minimize pallet-miles, together with decision factors 1-6 are supported by the ASSIGN model. The ASSIGN model, in itself, produces what is considered a good allocation of airlift capability. The REVISE expert system modifies the allocation provided by ASSIGN and results in a revised allocation decision based on decision factors 7-9 (Nygard, 1989:3).

QUICKTRANS Routing Method. The QUICKTRANS system utilizes judgemental factors to establish the current routing system. Additionally, the less complex and more densely concentrated QUICKTRANS system is routed to satisfy demands at each hub location. Essentially, the QUICKTRANS

systems has evolved (and continues to do so) to satisfy point-to-point demand (Bryan, 1990).

Productivity

The objective of the research is to determine whether combining the QUICKTRANS and LOGAIR systems would result in improved operations and reduce costs. The best measure of effectiveness of the combined systems appears to be a measure of productivity. Tyworth and others define productivity as "the ratio of real output produced to real resources consumed" (Tyworth, 1987:444). Chase and Aquilano define productivity as a measure of output divided by inputs (Chase, 1989:30). In both LOGAIR and QUICKTRANS outputs are tons of cargo moved over a measured mileage. A common measurement for freight (cargo) is the ton-mile. A ton-mile reflects the weight of the shipment and distance it is hauled; or multiplication of total tons (cargo) moved and the distance (mileage) traveled (Coyle, 1986:513). Finally, the "real resources consumed" for the LOGAIR and QUICKTRANS system are money.

Summary

The literature review provided a broad range of factors that affect the combining of the LOGAIR and QUICKTRANS systems. The legal and procedural aspects were examined along with analysis of the separate route structures. The review of the location and routing theories served as the foundation from which the chapter three (methodology) used to build the route models. Finally, the discussion of

productivity measurements provided the foundation for the measure of merits of the route models.

III. Methodology

Introduction

With the anticipated reductions in military personnel strengths and impending budget cuts it is imperative that economies of operation be explored within the defense arena. The focus of this research was to investigate whether merging the LOGAIR and QUICKTRANS systems improves operations and reduces cost.

This chapter provides insight into the benefits of a combined, QUICKTRANS and LOGAIR, route structure. This section was required since, unlike many of the benefits of the combined contract air cargo system, the combined route structure cannot be generated through the interpretation of a literature review.

The methodology chapter was subdivided into three main topics: a general description of the methods used to collect the data, a description of the methodology used to determine a combined LOGAIR and QUICKTRANS system or model, and a summary of the application of this methodology used to answer the investigative questions.

Collection of the Data

To establish a benchmark for evaluating a combined routing system required that the current route locations, costing data, cargo demands, planning factors, and cargo

carrying aircraft operating characteristics be collected. The following paragraphs detail this collection process.

Route Locations and Cargo Demand. Current route locations and originating and terminating cargo demands were requested from both LOGAIR and QUICKTRANS operations. It was initially assumed that both LOGAIR and QUICKTRANS data characteristics would remain static or constant as originally reported at the beginning of the Fiscal Year (1990). However, both QUICKTRANS and LOGAIR route structures are dynamic and robust. Both QUICKTRANS and LOGAIR were highly responsive to changing cargo demands and their respective route structures had been modified, several times since 1 October 1989, to provide more responsive cargo delivery (Wiese, 1990 and Warren, 1990). To deal with the dynamic nature of the route structure the existing patterns and corresponding nodal locations as 1 June 1990 were utilized.

Historical cargo demand data for Fiscal Year 1989 was used, since this was the most complete and readily available data from both QUICKTRANS and LOGAIR. In some cases, cargo demands for route locations were not available or the location was considered a marginal location so it was ignored and not listed as part of the route structure. Several locations within the QUICKTRANS system, although identified as part of route, did not have readily available cargo demand data since these locations were tracked through a separate monitoring system. In these cases dummy cargo

demands were used, as a mechanism to evaluate the productivity of the original route and the route model stemming from this research. The combined route structure, 81 locations, summed both contract air cargo system's demands at common locations together. In cases where both the QUICKTRANS and LOGAIR systems had the same three letter airport code the sum of combined total cargo demand is listed. Finally, to provide a relative distance data indicator, the Longitude and Latitude of each location was researched and listed. The individual and combined route or nodal locations along with the originating and destination (terminating) cargo demands are listed in appendix A.

Aircraft Operating Data. Aircraft operating data were provided by AFLC and NAVMTO for the LOGAIR and QUICKTRANS systems respectively. The LOGAIR system uses a larger mix of aircraft than the QUICKTRANS system. The LOGAIR aircraft include the L-100, DC-9, B-727, L-188, and the CV-640. The QUICKTRANS system uses the L-100 almost exclusively on all aircraft route patterns. However, there are provisions for substitution with the L-188 within the QUICKTRANS system (Warren, 1990). The aircraft performance data is listed in appendix B. The aircraft performance data, excluding the CV-640, were extracted from the Part III of the AFLC FY 90 Flight Schedules and Routing Guide. The QUICKTRANS L-100 contract with Southern Air Transport, Inc. references the same operating characteristics that the LOGAIR system uses.

so there is no conflict. The CV-640 (Convair-640) performance data were extracted from a Convair-640 performance data book provided to HQ AFLC by Zantop International Airlines, Inc.

Planning Factors. The goal of generating a combined routing model was to determine whether there was inherent excess capacity, from either system, that could be eliminated to result in more productive system. It was the expectation that by using planning factors similar or common to either QUICKTRANS or LOGAIR the resultant model would recognize any efficiencies of a combined system. The planning factors used are listed in Appendix C.

The LOGAIR system uses the Enhanced Transportation Automated System (ETADS) to perform or generate many of their planning tasks. The ETADS is an advanced worldwide Air Force cargo management system. It provides AFLC with an on-line responsive management information system (Dept of the Air Force AFR 76-1, 1990:Chap 15). ETADS provides planning factors, for commercially contracted aircraft, that recognize that pallet/net weight and any unique aircraft or cargo configuration reduce the contracted Allowable Cabin Load (ACL) to what is termed "available cargo weight". As an example, the L-100 aircraft has an initially contracted ACL of 46,000 pounds of guaranteed cargo carrying capacity. When the weight of the pallets/nets and the requirement for an enhanced aisleway are factored out of this guaranteed cargo weight, the "available cargo weight" is reduced to

40,981 pounds (Dept of the Air Force AFR 76-1, 1990:Chap 6). Additionally, the "available cargo weight" for trucks is established at 24,000 lbs for LOGAIR planning purposes (Wiese, 1990).

Since this routing problem is a type of traveling salesman problem, factors such as the tour length limits, service time at each node, and the speed of the cargo vehicles must be quantified. Appendix B provides the cruising speed of all aircraft as reported in FY 90 Flight Schedules and Routing Guide. A common planning factor for determining the cruising speed of trucks is reported to be approximately 40 to 45 miles per hour (mph) (Wiese, 1990). The time expended by the cruising aircraft to circle, land, taxi, and takeoff are not considered in the individual aircraft cruising speeds. A useful tool for determining the relative time elapsed by cruising aircraft is the block hour. The block hour takes into account the time an aircraft spends taxing before and after landing. However, the LOGAIR and QUICKTRANS routes normally have multiple stops and each route has various lengths of flight between each location. With this type of route sequence the block hour formulation loses much of its dependability. For the purposes of this route formulation, the planned service time at each location was used along with the "rule of thumb" time for taxing (after landing and prior to takeoff). The cargo service times are also included in Appendix C and were extracted from the MAC contracts per section B. The normal,

"rule of thumb", taxi times are 20 minutes after landing (before block in) and 20 minutes before takeoff (after block out) (Peschka, 1990).

Additionally, all routes are constrained by the traveling salesman requirement. Thus all salesmen (aircraft crews and truck operators) are required to return to the origin (hub), rest, or be replaced by another crew within the normal crew or operator day. For aircraft crews, crew day is defined as eight hours flying or sixteen hours total crew time, whichever comes first. For truck operators, crew day is defined as eight to ten hours of driving. However, a dual driver concept can lengthen this time to between sixteen to twenty hours (Wiese, 1990).

Costing Factors. The costing factors for the LOGAIR and QUICKTRANS system were extracted from the MAC aircraft contracts, the NAVMTO terminal contract, and surface freight costing factors as reported by QUICKTRANS and LOGAIR personnel. The costing factors are listed in Appendix D. The aircraft costing factors are reported in terms of dollars per Great Circle Statue Mile (GSCM) and dollars per directed landing. Based on this formulation, the LOGAIR and QUICKTRANS contractors are paid not on the volume or tonnages of cargo moved, but on the number of miles flown. The contractor would still get the same payment regardless of the utilization of available Allowable Cabin Load (ACL).

Model Methodology

A basic goal of the methodology was to use a relatively easy routing method that provided accurate results in a very short period of time. The QUICKTRANS and LOGAIR systems fall within the category of a "prohibitively complex" routing problem. The one alternative suggested by Chan for "prohibitively complex" routing problems was the use of heuristic approximation techniques. In his opinion, these heuristics perform quite well for operational needs (Chan, 1990:33). Two separate research studies, one by Merrill and another by Carter, use a Spacefilling Curve (SFC) heuristic for the purposes of routing aircraft. Merrill found the SFC to be no more than 10% from the optimum route possible (Merrill, 1989:65-66). Carter found the SFC heuristic provided the identical aircraft routes as provided by the more conventional linear program method. However, he found the SFC arrived at solution in a fraction of the time that it took the linear program. In one case, the SFC provided a route solution when the linear program could not arrive at an answer (Carter, 1990:52-56). Merrill also indicated that the SFC provided rapid results. He concluded the SFC provided good results while only requiring 1% of time needed using more conventional methods (Merrill, 1989:75).

The simplicity and usefulness of the SFC heuristic is described by Bartholdi et al. (1983) where a commercial

routing system was implemented without the use of a computer. The system provided for the daily routing of four vehicles to 200-300 locations. The system was maintained by one person and required the use of only two Rolodex card files. The system cost less than \$50 and shortened the average travel times by 13% over the previous method (Bartholdi, 1983:1-7).

Bartholdi and Platzman indicate that SFC heuristics would be useful for solving Vehicle Routing Problems (VRPs) (Bartholdi, 1988:296). VRPs are capacity constrained Traveling Salesmen Problems (TSPs) and simulate, very well, the conditions of the QUICKTRANS and LOGAIR systems separately and combined. Bartholdi and Platzman indicate that TSPs with precedence and/or capacity constraints can be solved (via heuristics such as "nearest neighbor") after the problem has been converted from the unit square to the linear unit interval (Bartholdi, 1988:296).

Spacefilling Curve Heuristic. The selection of the Spacefilling Curve heuristic as the method of providing a combined route structure requires some detail presentation of how this heuristic functions. The Spacefilling Curves were introduced by mathematicians Peano (1890), Hilbert (1891), and Sierpinski (1912). Initially this family of heuristics were described as "topological monsters" since they defied intuition by allowing a lower-dimensional space to be mapped continuously onto a higher-dimensional space. However, spacefilling curves continue to interest

mathematicians and computer scientist because of their recursive structure, and for the surprise and visual delight they provide (Bartholdi, 1984:4).

A spacefilling curve is a continuous mapping of the unit interval onto the n -dimensional unit hypercube. Likewise, they are also described as continuous mappings from the unit interval onto the unit square (Bartholdi, 1984:3-4). This may not seem like the same comparison, however if the n -dimensional hypercube is $n=1$, then the n -dimensional form is a unit square. More simply explained, the spacefilling curve is a continuous line that connects all points within a space (n -dimensional unit hypercube). The following figure provides a 2-dimensional example. The space, a unit square, is partitioned into four quarters, each a square in itself. As the spacefilling curve progresses through each unit

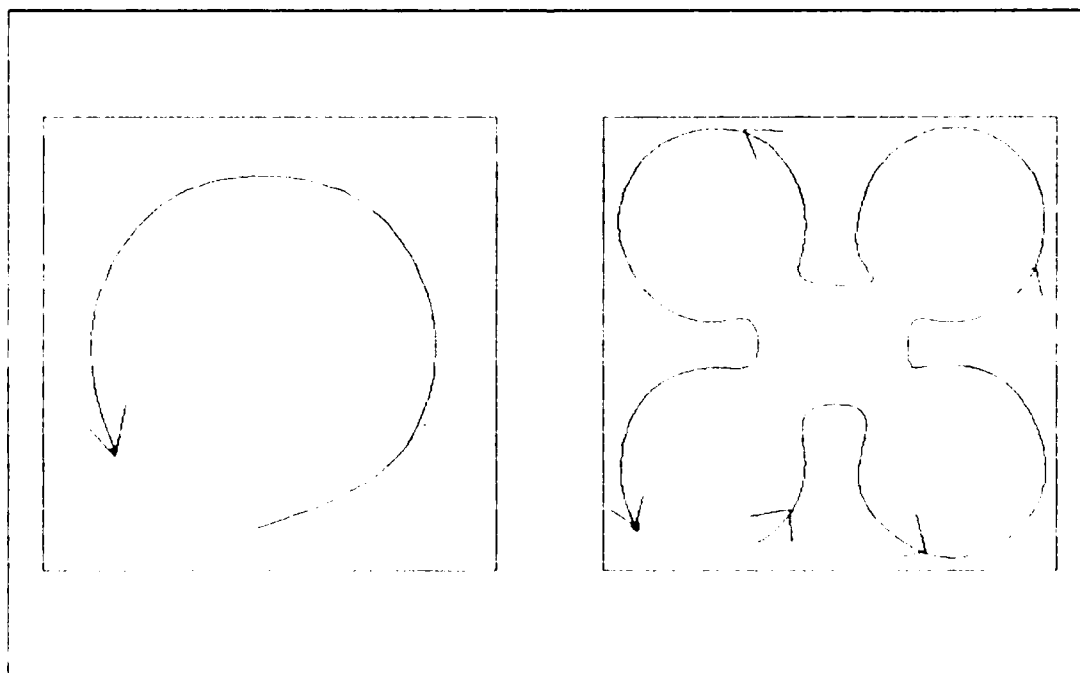


Figure 6: Two-dimensional Spacefilling Curve.

square it specifies the same value to all locations within the same quarter of the unit square. To provide a relative sequence within the square, the quarter can be broken down into additional quarters. The additional partitioning can continue in the series 4, 16, 64, until each location has a unique value on the curve.

A unique property of the spacefilling curves is that they tend to maintain "nearness" among points. It follows that, if two points are close on a curve then they are close in the plane. Conversely, if two points are close in the plane, then they are likely to be close on the curve. This capacity to preserve nearness is provided by the highly convoluted shape of the spacefilling curve. The spacefilling curve tends to visit all locations in one region of the plane before travelling to a new region (Bartholdi, 1984:4). As the previous figure indicated, the curve (line) continues to fill the square until all locations are accounted for and each location is recognized by a unit interval value.

The spacefilling curve can also provide answers on a 3-dimensional space (n-dimensional hypercube). As figure 7 illustrates, a 3-dimensional curve would operate similar to the 2-dimensional curve except it would initially have 8 separate cubes to tour. Again the cubes could be partitioned to provide a unique value for each location on the curve. 3-dimensional spacefilling curves have been successfully used to control cuts on flat surfaces by numerically-controlled machines and to direct the movement

of a mechanical plotter pen in real time. The advantage of using this type heuristic in comparison to a similar linear program solution is the overall speed of the spacefilling curve. The linear program will require $O(n^3)$ steps while the spacefilling curve only requires $O(n)$ steps (Bartholdi, 1988:295-296). O is nodal locations while n indicates the additional corollary nodal information like longitude, latitude, and distances between points.

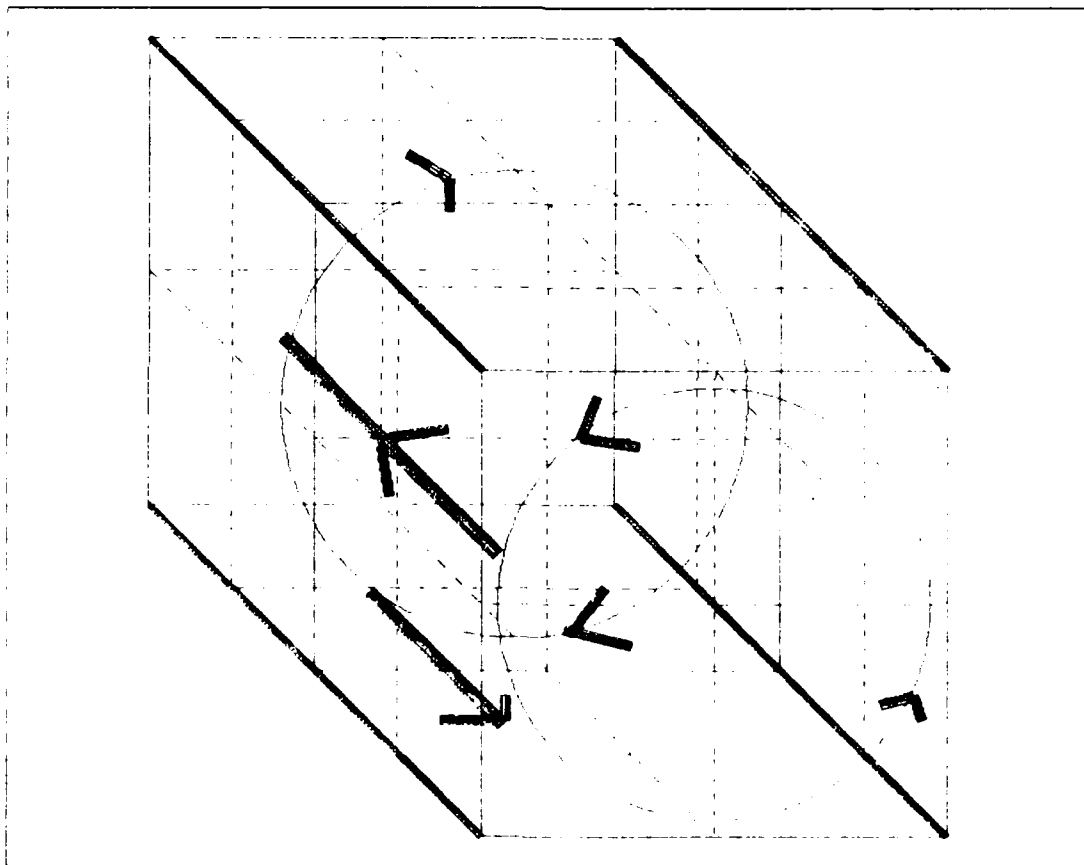


Figure 7: 3-Dimensional Spacefilling Curve

Finally, the spacefilling curve transforms the locations in the unit square, via the spacefilling curve (Figure 6 and 7), to a corresponding or unique value on the unit interval. Once all points are assigned a unit interval, along the

continuous spacefilling curve, these points are sorted according to their relative position on the unit interval (Bartholdi, 1988:293-294). As figure 8 illustrates a randomly scattered set of locations that is transformed through the use of the spacefilling curve to a set of values on a unit (line) interval. As previously mentioned, the lower line set of values preserves the "nearness" of points from the unit square. And the lower line provides an order sequence that the each location should be visited by the traveling salesman or vehicle that results in the shortest route through all locations.

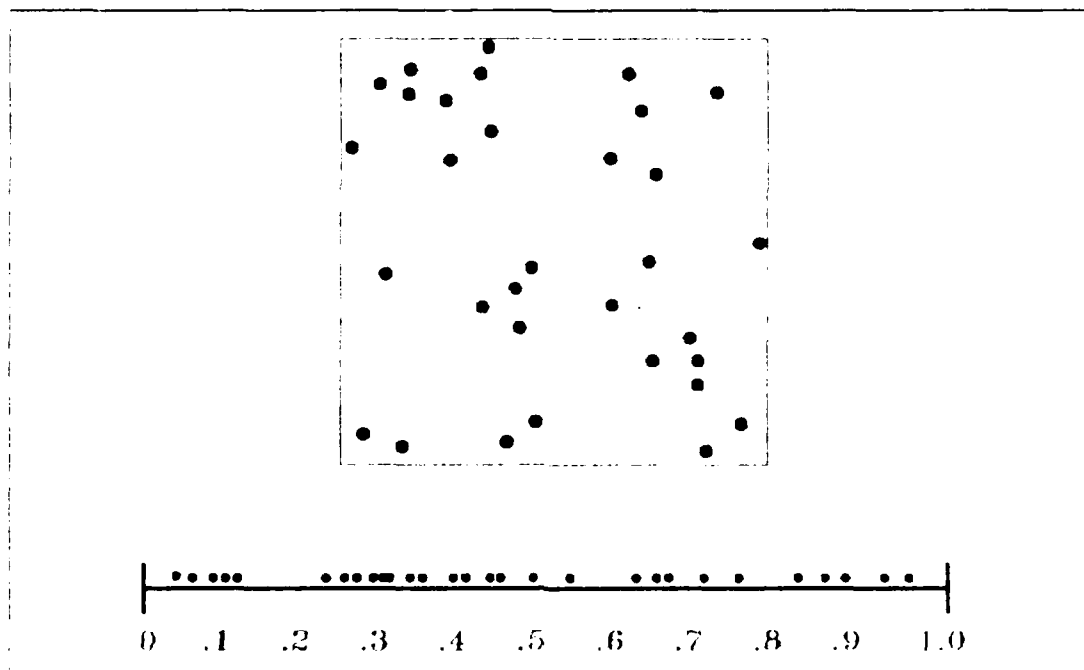


Figure 8: A set of locations in the square transformed to unit interval set on the line through the use of the spacefilling curve.

The spacefilling curve is described as the route of an obsessive salesman who visits all points in the unit square. The actual route visits only those locations required, but

in the same sequence as reported on the unit interval (Bartholdi, 1984:8-9). As figure 9 illustrates, the actual route indicated by the continuous line through the points results in the shortest route. The sequence of the locations visited is determined by the sequence from the unit interval.

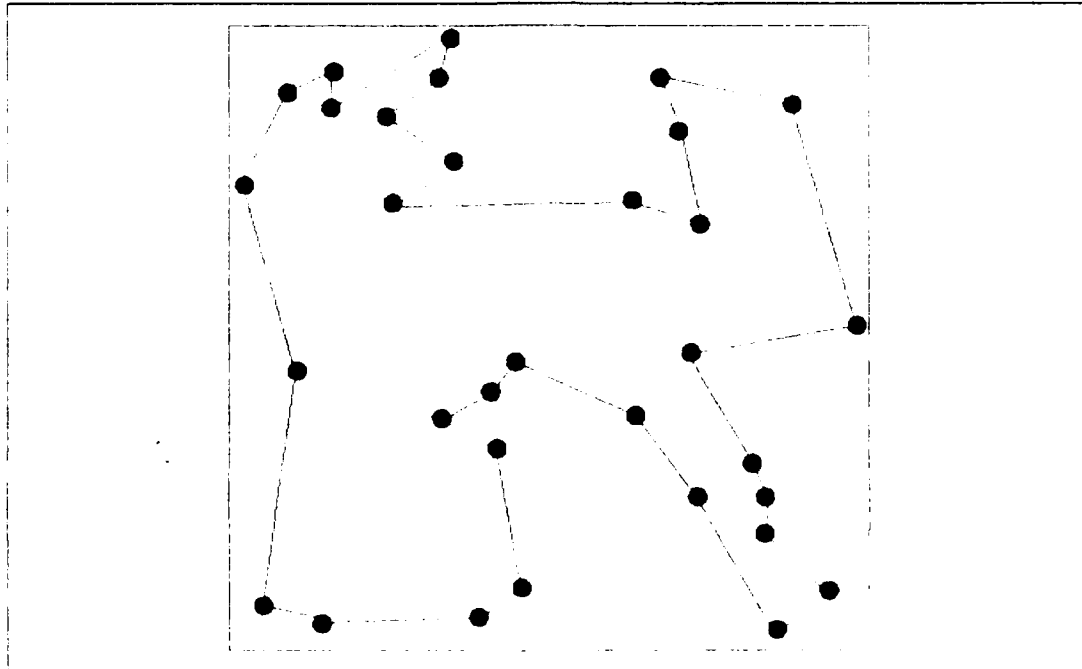


Figure 9: The heuristic traveling salesman's tour of all locations based on the sequence from the unit interval.

The spacefilling curve has numerous features that make it attractive for operational uses such as the routing of the LOGAIR and QUICKTRANS systems. First the heuristic is abstemious in its data requirements. It only requires the $O(n)$ coordinates of the points to be visited. In most cases a grid location such as longitude and latitude of each location is all that is required to specify these locations. The $O(n^2)$ distance between each location is not required.

By not requiring the $O(n^2)$ data the user is freed from the expense, time and money, of collecting that information. Second, the algorithm is extremely fast. Essentially, the algorithm consists of sorting, and so can be implemented to run in $O(n \log n)$ steps (worst case), and $O(n)$ steps (expected case). Next, the algorithm is agile. It can quickly update solutions in response to small changes in the problem. As an example: locations may inserted or deleted from the heuristic tour within $O(\log n)$ steps. In comparison, solutions provided by linear programs may need to be entirely re-solved when a location is added or deleted. Finally, the heuristic is "trivial to code". The actual code only requires about 20 lines of BASIC code (Bartholdi, 1988:293-294).

The LOGAIR and QUICKTRANS routes. The Spacefilling Curve heuristic was used to determine the combined route structure. However, as a control mechanism and to validate that any benefits realized from a combined route system were because of the inherent efficiencies of the combined system rather than the effectiveness of the route algorithm, a routing model was generated on the separate LOGAIR and QUICKTRANS systems. The effectiveness of the individual LOGAIR and QUICKTRANS systems was assumed at 100%, thus comparing the author's routes would provide a measure of effectiveness of the combined route.

The first step in the route algorithm, was to calculate for each location a corresponding position on the unit

interval. The locations were then sorted according to their positions on the unit interval. The unit interval for the Spacefilling Curve is between 0 and 1. Since this is a continuous line the unit interval 0 is closer to 1 than .9 is. In fact, the furthest distance from either 0 or 1 is .5. The route locations for the LOGAIR, QUICKTRANS, and combined systems were calculated and sorted by Spacefilling curve, the results are listed in Appendix E. The unit interval in Appendix E is called theta. As indicated previously, if two points are close in the plane they are likely to be close on the curve (Bartholdi, 1984:4). In this case the curve is the unit interval (theta) sorted in ascending order of precedence. Once the unit interval is sorted, the shortest route is, most likely, the route that visits each location in the order of precedence. However, the LOGAIR, QUICKTRANS, and combined systems are not shortest route problems, but a multiple traveling salesman (MTSP) and simple vehicle routing problems (SVRP) combined. In these cases the sorted unit intervals, theta, provide convenient groupings of locations that should be visited together; this assumption is valid as long as the vehicle capacity constraints and traveling salesman time constraints are not violated. For a perspective of the relative location groupings a graph of the theta versus the Spacefilling Curve rankings is provided in Appendix E.

The next step was a partitioning problem. This step determined which locations within the closely related

groupings would serve as the distribution points or the central hubs for other closely related locations. This step consisted of two parts: part one identified the central hub locations; and part two identified the locations to be serviced from a particular hub. As for the first part, the hubs could be considered restricted to the current hub locations in LOGAIR and QUICKTRANS systems. This was primarily because the current hubs serve as depot repair centers or logistic warehouse centers and generated or attracted a significant amount of cargo tonnages. However, as previously mentioned, the Spacefilling Curve can group and sort locational problems using a third dimension, in this case cargo demand. Appendix F exhibits the results of the three dimensional Spacefilling Curve algorithm on the LOGAIR, QUICKTRANS, and combined systems. As a further qualifier of the hub selection process, only those locations that could physically handle the processes of a hub were ultimately considered as a hub.

The second part to this step was to identify the individual locations that would be serviced from the potential hub locations. Both LOGAIR and QUICKTRANS systems attempt to minimize costs by minimizing the number of miles traveled by the cargo vehicles, aircraft and truck. This goal coincides with the classic location theories, presented in Chapter Two, that attempted to provide a least cost approach by minimizing the transportation cost on the product (Coyle, 1986:31-33). Relevant to this research,

LOGAIR and QUICKTRANS air transportation costs are based upon dollars per mile traveled rather than dollars per ton-mile (MAC Contract, 1990:Sect B). A method of minimizing costs attributable to transportation distances is to service those locations which are closest to a potential hub location.

The author found there was no readily available source of mileages, between all locations, that could be instantly and easily used for this task. As a result, the author resorted to building an inter-mileage matrix for the LOGAIR, QUICKTRANS, and combined systems. The results of this effort are accounted for in Appendix G. The actual methodology to produce this inter-mileage matrix required calculating the distances by the means of spherical trigonometry.

Distances on the Terrestrial Sphere. The earth is not perfectly spherical. But, normally in evaluating reality with the use of mathematics, we replace a complicated reality with a simpler model which approximates it with acceptable accuracy. In the navigational problems the actual earth is replaced by a simpler approximation called the terrestrial sphere (Richardson, 1950:332-333). Historically, by observing the positions of the sun and stars, navigators were able determine their location, latitude and longitude, on the earth's surface. Knowing the longitude and latitude of their location and any other location the number of miles separating the two locations

can be calculated by the means of the following spherical trigonometry formula:

$$\cos p = (\cos a \times \cos b) + (\sin a \times \sin b \times \cos P) \quad (1)$$

where

$a = 90^\circ - \text{latitude of location B}$

$b = 90^\circ - \text{latitude of location A}$

$P = |\text{longitude of A} - \text{longitude of B}|$

where p is the complement of the angle APB or the great-circle track joining location A to B (See Figure 10), a is the angular arc distance for location B from the north pole P, b is the angular arc distance for location A from the north pole P (Welchons, 1943:206).

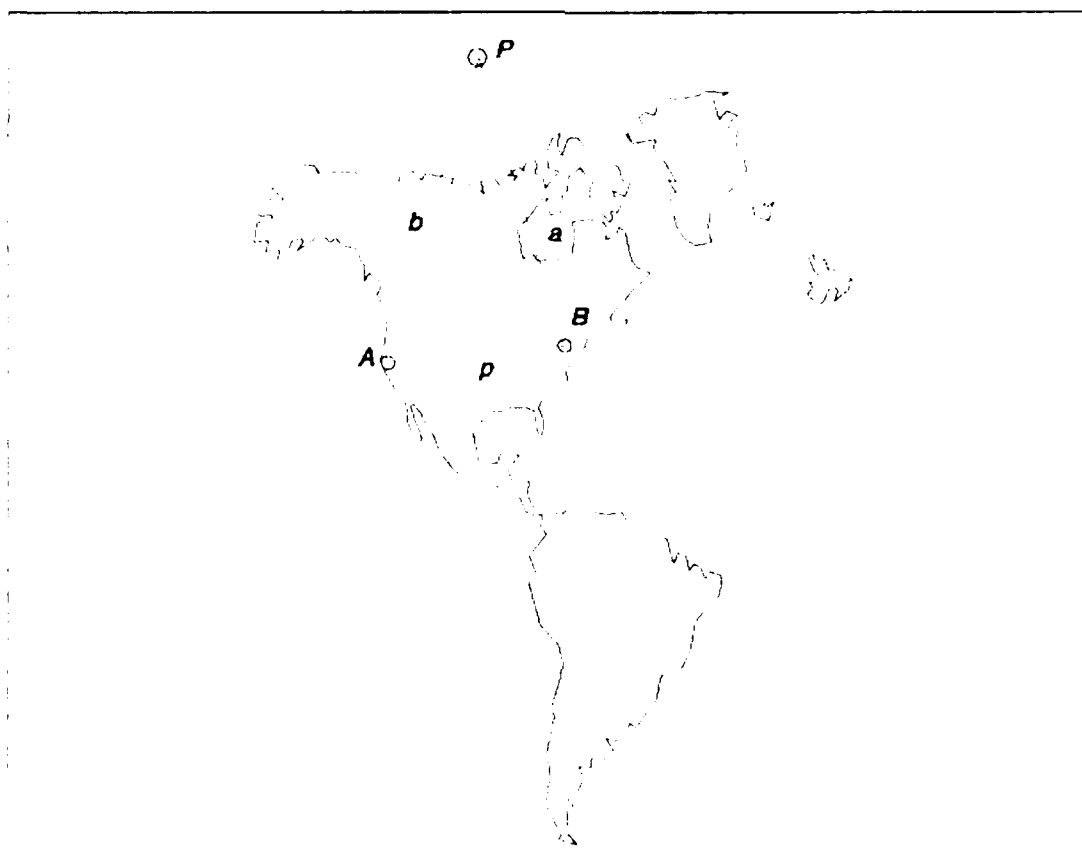


Figure 10: Distances on the Terrestrial Sphere.

For example, the distance from A (Travis AFB, CA), 38.16° North latitude and 121.56° West longitude, from B (Dover AFB, DE), 39.08° North latitude and 75.28° West longitude, can be calculated by using Eq(1). From figure 10,

$$a = 90^\circ - 39.08^\circ = 50.92^\circ$$

and

$$b = 90^\circ - 38.16^\circ = 51.84^\circ$$

and

$$P = |121.56^\circ - 75.28^\circ| = 46.28^\circ.$$

Substituting in the formula (Eq(1)),

$$\cos p = (\cos 50.92^\circ \times \cos 51.84^\circ) + (\sin 50.92^\circ \times \sin 51.84^\circ \times \cos 46.28^\circ).$$

$$\cos p = (.6304 \times .6178) + (.7762 \times .7862 \times .6911).$$

$$\cos p = .3895 + .4218.$$

$$\cos p = .8113$$

$$p = 35.77^\circ$$

Since 1° is approximately 69 miles, $p = 2468$ Great Circle Statute Miles (GCSMs) (Welchons, 1943:206).

A random check of several of the mileage figures in Appendix G with known distances figures (AFLC) found that this formula resulted in no greater than a 3% deviation from in use sources. However, the 3% deviations were found to be the exception while most mileage figures deviated by less than 1%.

Additionally, the author required a reasonable method of calculating surface mileage between locations. The surface distances were required to determine overall mileages for

each route structure and was needed to permit the evaluation of the existing routes and models. AFLC has determined that a good representation of surface mileage is 120 percent of the air miles (Wiese, 1990). The surface mileage were calculated, with the aid of a spreadsheet. The results are contained in Appendix G.

Hub Selection. Once the distance figures were made accessible, the locations with the minimal distance to the servicing hubs were found with the use of a spreadsheet. The locations were sorted according to those hubs which they were closest to (Appendix H). Individual locations were manually reassigned if, according to the Spacefilling Curve (Appendix E), a location was in a grouping that was serviced by another hub.

As an example, in both the LOGAIR and combined models BYH (Ira Eaker AFB AR) was identified through the Spacefilling Curve, Appendix E, as belonging to a related group of MEM (Memphis TN) and others. However, BYH was identified by the spreadsheet as being closer in distance to FFO (Wright-Patterson AFB OH) than any other hub. Rather than violate the Spacefilling Curve groupings BYH was manually moved to be served by WRB (Robins AFB GA) which also serves MEM. This methodology maintains the convenient groupings of the Spacefilling Curve and still provides a good representation of distance minimization from the servicing hub. This methodology was used several times in rationalizing the best locations to be serviced by the required hubs. In several

instances, hubs were identified as servicing one or less locations. In these instances, these hubs were maintained as part of a master hub route but the single service locations were reallocated to the hub which serviced the most closely related location groupings in Appendix E. Finally, after all locations were allocated to specific hub locations, new unit intervals were calculated through the Spacefilling Curve. The results are indicated in Appendix I. Additionally, Appendix I results contain the average daily demand, in pounds, for cargo for all locations. The average daily demand was calculated by dividing the Fiscal Year 1989 yearly demand by 365. This daily demand was required to determine when the cargo vehicles, aircraft and truck, have exceeded their carrying capacities on each route.

Route Selection. Bartholdi and Platzman provide a method of solving Vehicle Routing Problems with the use of a 2-dimensional Spacefilling curve. Their procedure indicated that closely related locations should be grouped according to their demands without violating the cargo vehicles, aircraft and truck, capacity (Bartholdi, 1988:296). Carter in his 1990 thesis, Allocation and Routing of CRAF MD80 Aircraft, used this procedure for the allocation of patients for aeromedical evacuation. The procedure provided the same results as the more conventional linear program, and one case was able to provide a route structure when the linear program could not (Carter, 1990:53-54).

Table 1 was extracted from Appendix I and shows the location groupings around the FFO hub (Wright-Patterson AFB OH) as sorted by the Spacefilling curve. As mentioned

TABLE 1
Location Grouping for Wright-Patterson AFB
Using the Spacefilling Curve

RANK	CODE	NAME	LAT	LONG	THETA	DAILY POUNDS
1	NKO	NEWARK	40.04	82.24	0.00000	127
2	FFO	WPAFB (HUB)	39.49	84.03	0.01563	14867
3	IND	WEIR COOK AP	39.43	86.16	0.06250	4135
4	GUS	GRISSOM	40.39	86.08	0.06250	90
5	DLH	DULUTH	46.50	92.11	0.45313	525
6	SAW	K.I. SAWYER	46.21	87.23	0.60938	1507
7	OSC	WURTSMITH	44.27	83.24	0.93750	1821
8	MTC	SELFRIEDGE	42.36	82.50	0.95313	896
TOTAL POUNDS CARGO LESS WPAFB = 9101						

before, the daily cargo demand is provided in the last column to help indicate when the vehicle capacity is reached.

To further strengthen the route selection procedure Carter enhanced the 2-dimensional Spacefilling curve results by graphing the theta results (x-axis) against the demand or cargo tonnages (y-axis) (Carter, 1990:52). Figure 11 is extracted from Appendix I and depicts the 2-dimensional Spacefilling results (theta), for FFO hub (WPAFB) location grouping, on the x-axis and the daily cargo tonnages on the y-axis. Simply explained, the route selection procedure was to route a selected vehicle around a group of closely related (theta) locations without exceeding the capacity

SPACEFILLING CURVE ROUTE SELECTION WPAFB HUB ROUTING

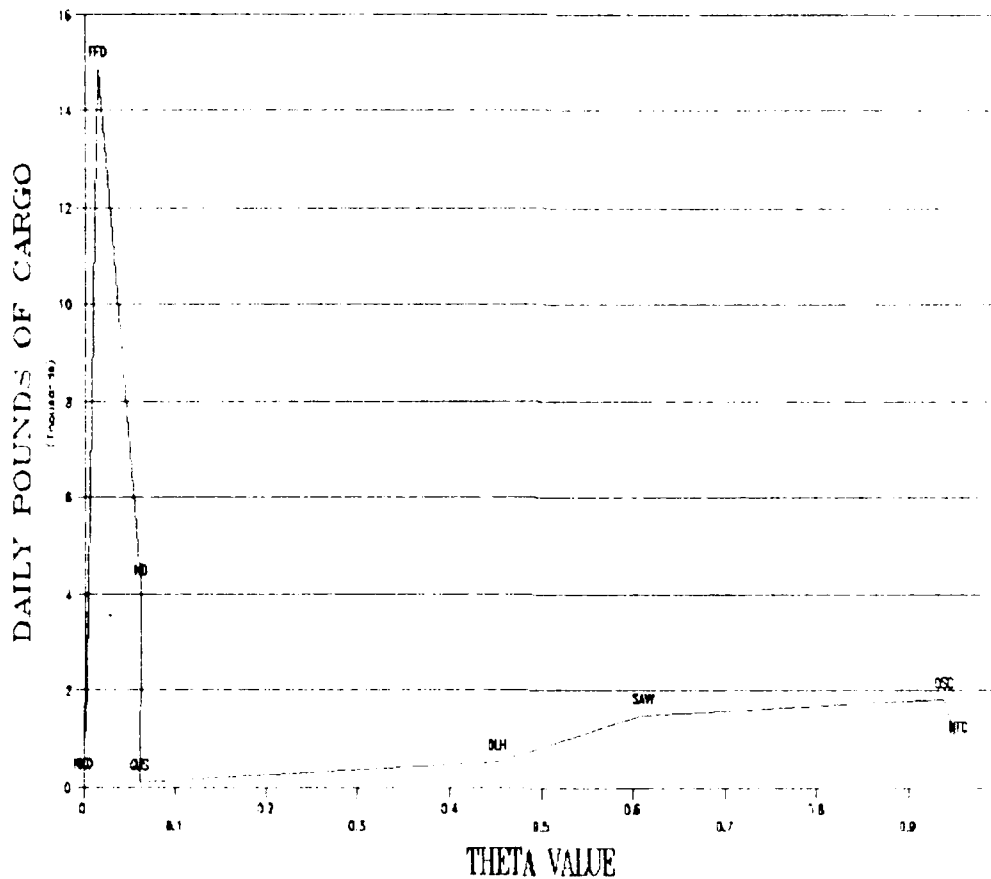


Figure 11: Extract from Appendix I showing 2-dimensional Spacefilling curve (theta) results graphed against daily cargo demand for service locations.

(planning factors) of the selected vehicle or operators. The capacity or planning factors for the vehicles and operators can be found in Appendix C. The current LOGAIR and QUICKTRANS systems operate about 6 days per week (Wiese, 1990 and Warren, 1990). This route selection focused on the 6 day planning factors for the route selection to more

closely mimic the current routing structures of LOGAIR and QUICKTRANS.

By starting at the hub FFO (See Table 1 and Figure 11), the locations are fairly well separated except for a small group of locations: IND (Weir Cook AP), NKO (Newark), and GUS (Grissom). Because of their close proximity to the hub the vehicle chosen for the cargo delivery for IND, NKO, and GUS was truck transportation. Accordingly, the closely related theta values of GUS, IND, and NKO indicate they can be effectively routed in one trip. However, since the total mileage exceeds the traveling salesman requirement of 360 miles (8 hours operator time x 45 miles/hour = 360 miles) the route was satisfied by two trucks. Since GUS and IND shared the same theta value, truck route 7 was dedicated to these locations while truck route 8 was dedicated to NKO. Table 2 below provides an extract from Appendix J documenting the final routes.

TABLE 2
Selected Routes from Combined Route Structure
Extract from Appendix J.

Routes	Distances(MILES)
TRUCKS 7 MACK	
FFO IND	136
IND GUS	80
GUS FFO	151
TRUCKS 8 MACK	
FFO NKO	123
NKO FFO	123

DLH (Duluth), SAW (K. I. Sawyer), OSC (Wurtsmith), and MTC (Selfridge) are fairly well separated from the hub location, theta, and fairly well separated from each other. Since the daily cargo demand for all four locations was less than 5000 pounds the vehicle selected was the smaller CV640 (Convair 640) aircraft with an ETADS six day cargo factor of 13,434 pounds of cargo (Appendix C). All crews have a traveling salesman restriction of 8 hours actual flight time or 16 hours total operational time, whichever is reached first. Operational time includes: flight time, taxiing (landing and takeoff), and aircraft service time (after block-in and before block-out) (Wiese, 1990).

The total flight distance for the remaining locations was 1451 statute miles. The CV640, with a cruising speed of 300 miles per hour, will experience just slightly less than 5 hours of flight time. Taxiing and service time per location, not including the hub, will contribute approximately 8 hours and 40 minutes to the operational time. A general rule for service time can be rounded to 1.5 hours per location. The originating and terminating location do not provide service time for the crews since the aircraft are loaded, at the flight origination, prior to crew arrival and downloaded after crew departure at the flight terminating location. Since no limiting factors or constraints were violated this route was documented as route 19 for the combined system in Appendix J (See table 3).

TABLE 3

Selected Routes from Combined Route Structure
Extract from Appendix J.

Routes	Distances(MILES)
ROUTE 19 CV640	
FFO MTC	213
MTC OSC	137
OSC SAW	236
SAW DLH	233
DLH FFO	632

Several of the selected routes, especially the hub routes exceeded the weight capacity of the selected aircraft. In these cases, the author had the option to stop the route short and reroute a second aircraft for the remainder of the flight or route a second aircraft over the same route to deliver and pickup the excess. In most cases the routing of a second aircraft over the same route provided better service with less overall mileage. All completed routes can be found in Appendix J.

Spacefilling Curve Route Evaluation. The intent of routing methodology was to build a model that closely resembled the factors that resulted in the existing LOGAIR and QUICKTRANS systems. By doing so, the author hoped avoiding building a combined route model where all measurable efficiencies were attributable to the routing methodology. Also by measuring the efficiency of the author's LOGAIR and QUICKTRANS models a measure of merit was determined for the combined route model.

AFLC currently uses the DO65 modeling system to evaluate potential routes. The system is quite versatile and only requires inter-location fiscal cargo demand, distances between locations, and the names of the locations to give an evaluation of the potential routes. The DO65 provides a report indicating amount of cargo moved and cargo load factors per route. The DO65 was used to determine the effectiveness of the Spacefilling Curve to provide adequate routes and provided the author with a measure of merit of how well the routes were constructed.

The DO65 modeling system worked well with two limitations. First, the QUICKTRANS inter-locational cargo demand was not readily available from the NAVMTO sources. In lieu of actual data, an inter-locational cargo demand was built based upon the percentage allocation of cargo presented in the FY 89 total tonnages, Appendix A, per location. As an example, NGU (Norfolk, VI) received 10% of the total Fiscal Year cargo tonnages. As such, it was assumed that NGU, on the average, received 10% of originating tonnages from all locations. Although this assumption is not totally realistic it does provide an initial starting point for evaluation of the QUICKTRANS system and the author's QUICKTRANS model. The inter-locational cargo demand for the LOGAIR and QUICKTRANS systems are provided in Appendix K.

Second, the DO65 is restricted to a route model containing no more than 62 locations. This was fine for

evaluating either the QUICKTRANS or LOGAIR system, but the combined model containing 81 locations could not be evaluated using the DO65 system. However, the DO65 did provide a measure of efficiency (Percent of cargo moved and cargo load factors per route) of the LOGAIR and QUICKTRANS system that could be interpolated for the combined model.

Evaluation of Investigative Questions

The purpose of this section was to provide some generalized direction for answering the investigative questions. The investigative questions were answered through either the information provided in the literature review or through the interpretation of the provided route models in Chapter 4.

Question One. What are the similarities and differences between LOGAIR and QUICKTRANS:

A. In the production process (labor resources, material handling, facilities, and route structure).

B. In the cost structure (shipping rates and maintenance of the aircraft).

C. In the procedural structure (cargo movement selection and method of routing cargo).

D. In the managerial structure (public law, DOD regulation, and service regulation).

The information provided in the literature review was sufficient to provide answers to the inquiries in question one.

Question Two. What methods could be used to effectively combine the QUICKTRANS and LOGAIR system?

The results of the Spacefilling Curve model were used to determine whether the combined system was beneficial (reduced costs with no apparent loss of service). Additionally, the D065 model was used to determine how effective the Spacefilling Curve models were compared to current LOGAIR and QUICKTRANS systems.

Question Three. What would be the cost/benefits of combining the QUICKTRANS and LOGAIR systems?

This analysis focused on apparent efficiencies of sharing common locations and any derived efficiency of the shared route structure. A true measure of benefits directly tied to costs would be a reduction in the total route air mileage. This assumption is based upon air cargo costs being linked to the total mileage per route and not the amount of cargo tons moved.

Summary

Chapter Three provided the insight into the benefits of a combined, LOGAIR and QUICKTRANS, route structure. It established the parameters for building the route structure based on the current route characteristics and readily available cargo data. It introduced an amazingly fast and accurate heuristic, the Spacefilling Curve algorithm, for building the route models. And it established a method through the D065 Logistics Air Lift Computer Model for evaluating the effectiveness of the author's route models.

Finally, it established the generalized rules for analysis of the results.

IV. Results and Analysis

Introduction

This section answers the investigative questions posed in chapter one through the interpretation of the literature review and analysis of the results from the routing models. This chapter was organized around the investigative questions to provide a logical continuity to the rest of the thesis. The focus of the investigative questions was to determine whether merging the LOGAIR and QUICKTRANS systems would improve operations and reduce costs.

Question One. What are the Similarities and Differences Between LOGAIR and QUICKTRANS:

The interpretation of the literature review, in most cases, was sufficient to answer the sub-questions and, ultimately, Question One. Surprisingly, the similarities were more common than the differences within the LOGAIR and QUICKTRANS systems. This was more attributable to the common governance by the same Department of Defense regulation, DOD 4500.32R, than anything else.

Similarities and Differences in the Production Process (Labor Resources, Material Handling, Facilities, and Route Structure)

Labor resources for the two systems are significantly different. Other than the vehicle operators, pilots and truck drivers, the LOGAIR system maintains its entire labor force composed of active duty military and civil servants.

This includes the management force and aircraft terminal labor force (Wiese, 1990). Unlike LOGAIR, the QUICKTRANS system is nearly all contract labor. This includes all terminal services (except Charleston AFB) and all other associated labor resources excluding upper management (Bryan, 1990). The amount of contract services performed for the QUICKTRANS system may detract from a perceived capability to provide flexible cargo movement service. On the other hand, the large amount of contract services may be a less expensive alternative to the LOGAIR system which maintains the entire personnel force internally.

The LOGAIR system supports its large mix of contract aircraft (L100, L-188, DC-9, and CV-640) with a sufficient variety of materials handling equipment. This entire fleet of materials handling equipment is provided and maintained by the individual Air Force bases on which the LOGAIR stations are located (Wiese, 1990). Conversely, QUICKTRANS as part of their terminal facilities contract, have the contractor provide the necessary materials handling equipment (Bryan, 1990). However, since the QUICKTRANS system is almost exclusively serviced by L-100 aircraft and truck, the variety of material handling equipment is not as great as the LOGAIR system (Only on the LOGAIR and QUICKTRANS shared route in Florida, 5Q, does the QUICKTRANS system routinely service the L-188 aircraft). However, the QUICKTRANS terminal services contract does require the

contractor to service substitute or diverted aircraft (Navy, 1990:IIA2.1.).

Both the LOGAIR and QUICKTRANS facilities, since both are located on government reservations, are provided by the Navy and Air Force (Warren, 1990 and Wiese, 1990).

Although the LOGAIR and QUICKTRANS systems have basically the same mission, the priority movement of spares in support of the services first-line weapon systems, their route structures are significantly different. First, the LOGAIR system is comprised of approximately 60 locations fairly well evenly dispersed across the United States. Because of the significant distances between locations, this favors the resultant use of aircraft as the cargo vehicle of choice. Conversely, the QUICKTRANS system is comprised of approximately 30 locations densely stationed on both the east and west coasts. The relatively short distances between most locations favors the extensive use of the surface transportation system.

Although the QUICKTRANS and LOGAIR route structures are significantly different, both use basically the same general rules to establish the structure to provide rapid movement of spares in support of first-line weapon systems. These are evidenced by the contemporary route structures. Densely or closely situated locations are serviced by surface transportation modes while widely separated and high cargo traffic (hub) locations are serviced by air transportation modes. Basically, the significantly different route

structures of the QUICKTRANS and LOGAIR systems are not the result of by any established directive, but are as the result of good traffic management decisions to provide rapid movement of high priority cargo.

Similarities and Differences in the Cost Structure (Shipping Rates and Maintenance of the Aircraft

Both LOGAIR and QUICKTRANS provide cargo movement on a reimbursable basis. The QUICKTRANS system provides monthly computation of a rate structure that will provide reimbursement to the Navy Management Fund by QUICKTRANS users (Dept of the Navy, 1988:3 and Bryan, 1990). The LOGAIR system establishes a tariff structure, distributed annually, that documents the cost per pound for cargo moved between Air Logistic Centers, MAC Aerial Ports of Embarkation, and other selected LOGAIR points (Dept of A.F. AFR 76-1, 1990:Chap 1). The only difference between the two systems is that while the QUICKTRANS system is immediately reimbursed for all charges following the month of movement, the LOGAIR system uses, essentially, a standard cost that would result in reimbursement if the forecasted cargo demand is consistent. From a customer's point of view the up-front LOGAIR tariff cost may be preferable to the anticipated reimbursement charge tendered by the QUICKTRANS system. However, this should not represent a severe obstacle to a combined system, since it represents only a method of reimbursement for services provided.

The costs for maintaining the contracted aircraft are identical. The contractor is responsible for maintaining the aircraft for both the LOGAIR and QUICKTRANS systems. Additionally, both QUICKTRANS and LOGAIR aircraft contractors are reimbursed dependent upon the number of Great Circle Statute Miles covered not on the number of tons of cargo transported (MAC Contracts, 1989 & 1990:Sect A). Surface transportation costs are represented by standard commercial tariff rates which are essentially dollars per hundred-weight of cargo moved (Wiese, 1990 and Warren, 1990). Basicly all outlays for purchased cargo service by both QUICKTRANS and LOGAIR are identical and pose no significant barrier to a merged system.

Similarities and Differences in the Procedural Structure (Cargo Movement Selection and Method of Routing Aircraft)

Selection of cargo for movement along either system, QUICKTRANS and LOGAIR, is governed by a common regulation. DOD Directive 4500.32R, *Military Standard Transportation and Movement Procedures*. As part of the Defense Transportation System (DTS), cargo entering either contract airlift system, either for surface (export) or air movement, requires clearance into the DTS (DOD MILSTAMP, 1988:2-B-15). All cargo offered to shipped by QUICKTRANS and LOGAIR, must be cleared by the Air Clearance Authority (ACA) for each service. This common DOD governing directive essentially results in both QUICKTRANS and LOGAIR air transporting the same priority classes of cargo: MICAP/999, TP-1, TP-2, and

TP-3. TP-3 is not normally recognized, by either system, as readily "air eligible", but MILSTAMP permits TP-3 movement by air unless expressly disapproved (DOD MILSTAMP, 1988:2-B-17) and LOGAIR increases the airplane load factors with the movement of TP-3 cargo (Wiese, 1990).

Actual routing of the aircraft or trucks for movement of the high priority cargo is done by selectively different methods in both the QUICKTRANS and LOGAIR systems. LOGAIR uses the DO65 modeling system to establish and evaluate potential routes and route structures. Once a route is established the Allocate system is used to distribute cargo pallets to aircraft. The model provides maximum shipment of priority pallets and minimizes the pallet-miles (Nygard, 1989:3).

The more densely concentrated QUICKTRANS system satisfies demand through the hub network and then satisfies the point-to-point demand onward (Bryan, 1990). Although less sophisticated than the LOGAIR routing process, the QUICKTRANS process provides the same results, a useable routing system. However, if combined, the processes used by LOGAIR system may be more advantageous to formulating the combined route structure.

Similarities and Differences in the Managerial Structure (Public Law, DOD Regulation, and Service Regulation)

Both QUICKTRANS and LOGAIR are not specifically authorized by any public law. However, they are permitted to exist through an interpretation of the funding by the

Defense Authorization and Appropriation Acts. Neither system is a separate line item, but they are collectively funded within realm of Second Destination Transportation (Figueroa, 1990).

As mentioned previously, QUICKTRANS and LOGAIR are governed by a common regulation, DOD Directive 4500.32R, Military Standard Transportation and Movement Procedures. Given this common DOD governance, the individual service regulations are, by legacy, very similar in scope and policy. The original premise for initiating the LOGAIR and QUICKTRANS systems was to provide dedicated air transport service (for spares) for each services first-line weapon systems (Navy, 1990:5 and Dept of A.F. AFR 76-1, 1990:20). However, since both systems are a component of the larger Defense Transportation System (DTS), movement of "other" services high priority cargo is authorized.

Question Two. What methods could be used to effectively combine the QUICKTRANS and LOGAIR system?

Following the recommendation of Chan and the guidance from two separate research studies, one by Merrill (1989) and other by Carter (1990) the Spacefilling Curve was used to combine the LOGAIR and QUICKTRANS systems. The use of the Spacefilling Curve Heuristic provided responsive and easily interpreted results to formulate a combined routing model and individual, LOGAIR and QUICKTRANS, routing models. The author found the two greatest attributes of the

Spacefilling Curve were that it was abstemious in its data requirements and the algorithm was extremely fast.

Being abstemious for data requirements made the Spacefilling Curve, in retrospect, the only algorithm available to provide a good model of the combine route structure. The data collection results did not provide many data points that were common to both the LOGAIR and QUICKTRANS. Thus, the Spacefilling Curve abstemious attribute was the difference between research success and failure.

The speed of the Spacefilling Curve Heuristic (each iteration of the program took less than 20 seconds) allowed for many practice attempts while becoming proficient at understanding algorithm output.

The final routing models provided results that were comparable to the current routes used. Using the DO65 modeling system to evaluate the route models, developed for the QUICKTRANS and LOGAIR systems, provided a measure of effectiveness of the Spacefilling Curve. The results of the DO65 analysis is contained in Appendix L (QUICKTRANS) and Appendix M (LOGAIR).

The DO65 analysis of the current QUICKTRANS system indicated that 64 percent of the total demand of 480,455 pounds (daily cargo) was satisfied. Although this does not appear very good it is important to remember that a portion of the QUICKTRANS cargo data requirements were interpolated to fit the needs of the DO65 system. The inter-locational

cargo demands, for QUICKTRANS, (Appendix F) were interpolated from the FY 89 total cargo demands and probably do not reflect the realistic cargo movements. However, this serves to establish a baseline from which the author's routing models can be evaluated.

The author's QUICKTRANS model generated a DO65 report (Appendix L) indicating 58.54 percent of the total demand of 480,455 pounds (daily cargo) was satisfied. However, this result is quite good considering that the current QUICKTRANS system is assumed to have transported 100 percent of all cargo, yet yielded only a 64 percent of total demand. Consequently the author's QUICKTRANS model yielded results only 5.46 percent less than the current optimum.

The DO65 analysis of the current LOGAIR system indicated that 100 percent of the total demand of 316,258 pounds (daily cargo) was satisfied. The difference in the analysis, between LOGAIR and QUICKTRANS, was the availability of the inter-locational cargo data for the LOGAIR system. The actual cargo movements could be evaluated with better effectiveness with this data file.

The author's LOGAIR model generated a DO65 report (Appendix M) indicating 98.89 percent of the total demand of 316,258 pounds (daily cargo) was satisfied. Consequently the author's LOGAIR model yielded results only 1.11 percent less than the current optimum.

The DO65 also provided the opportunity to evaluate individual routes and modify the route structure to improve

the percentage of cargo moved. However, since the combined route, containing 81 locations, was too large to use the DO65 modeling system, the author's LOGAIR and QUICKTRANS systems were not modified. In this manner, a comparable analysis of the combined route model with the author's LOGAIR and QUICKTRANS models could be justified.

Since cost for both LOGAIR and QUICKTRANS systems are more associated with miles traveled rather than tons of cargo moved the length of the routes were compared. The current QUICKTRANS system (Appendix J) yielded a total daily mileage of 22,708. Of this total, air mileage comprised 15,022 miles and surface mileage consisted of 7,686 miles. The author's QUICKTRANS model (Appendix J) yielded a total daily mileage of 16,440. Of this total, air mileage comprised 9,597 miles and surface mileage consisted of 6,843 miles. In comparison, the author's model used approximately 36 percent less airlift resulting in 5.46 percent less cargo being transported.

The current LOGAIR system (Appendix J) yielded a total daily mileage of 43,873. Of this total, air mileage comprised 41,893 miles and surface mileage consisted of 1,980 miles. The author's LOGAIR model (Appendix J) yielded a total daily mileage of 32,766. Of this total, air mileage comprised 25,792 miles and surface mileage consisted of 6,974 miles. In comparison, the author's model used approximately 38 percent less airlift and 352 percent more

surface transport resulting in 1.11 percent less cargo being transported.

A cursory review of the DO65 report shows that the author's cargo load factors for the hub routes are higher than the current systems and in some cases in excess of 100 percent. This quickly accounts for the slightly less than optimum cargo movement and accounts for significant difference in total mileage.

Using the above results it was assumed that the combined routing model would provide results that would be approximately 1 to 6 percent off the optimum route model. Additionally, the author's combined route model (Appendix J) yielded a total mileage of 48,449. Of this total, air mileage comprised 42,316 and surface mileage consisted of 6,133. This compares extremely well against the combined mileage of the current LOGAIR and QUICKTRANS systems. For convenience the results for the current systems and the author's model are provided in Table 4. The total of

TABLE 4

Tabulation of Routing Analysis
Indicates Mileage Consumed by Different Routes

	Current Routes		Author's Models		
	QTRANS	LOGAIR	QTRANS	LOGAIR	COMBINED
Air:	15,022	41,893	9,597	25,792	42,316
Surface:	7,686	1,980	6,843	6,974	9,666
Total:	22,708	43,873	16,440	32,766	48,449

current systems yielded a total daily mileage of 66,581. Of this total, air mileage comprised 56,915 miles and surface mileage consisted of 9,666 miles. Based on the effectiveness of the first two models, it was not surprising that the author's model used 27 percent less mileage to accomplish the same task.

Question Three. What would be the cost/benefits of combining the QUICKTRANS and LOGAIR systems?

The first benefit of the proposed combined system was location rationalization. Combining the locations into the combined model reduced the sum of locations, QUICKTRANS and LOGAIR, from 89 locations to 81. These eight locations were common to both the individual cargo systems. Assuming the eight common locations duties can be absorbed by the existing LOGAIR structure, then a 3 million dollar savings is realized since the eight locations comprise 25.8 percent of the FY 89 QUICKTRANS Terminal Services Cost (Appendix D) of nearly 12 million dollars. However, this costing analysis does not imply that the LOGAIR organic terminal structure is more favorable than the QUICKTRANS contracted terminal services. It merely indicates that the QUICKTRANS terminal services costing figure were more convenient to use.

Again, since the cargo contractor was reimbursed, generally, on the basis of number of miles traveled rather than the number of tons transported, an analysis of cost of the reduced miles was required. The author's combined route

model yielded 27 percent less mileage than the sum of the two current stand alone systems. Assuming all other factors are equal, the author's combined system would cost 27 percent less than the combined stand alone systems. With nearly 114 million dollars (Appendix D) attributable to cargo movement, LOGAIR and QUICKTRANS, the 27 percent reduction in mileage equates to over a 30 million dollars savings per year.

A derived benefit of the combined system would be enhanced use of the separate systems excess capacities. Since the LOGAIR and QUICKTRANS are regularly scheduled routes, excess capacity is inherently built into the system to ensure all cargo is moved within a certain time frame. A combined system could use these excess capacities to improve load factors on parallel route structures and reduce the required route structure to provide the same service. The 27 percent reduction of mileage with author's route model was an example of this excess capacity.

Summary

This chapter provided results and analysis of the research effort formatted to answer the original investigative questions. The similarities and differences of the LOGAIR and QUICKTRANS system were examined and the results indicated there were significantly more similarities than differences. The similarities of two systems can be directly linked to a common membership within DTS and by

common governance by DOD Directive 4500.32R, MILSTAMP. The Spacefilling Curve algorithm furnished routing models that, when compared against the current systems, resulted in cargo movement that was within 1 to 6 percent of optimum. Additionally, the combined model yielded a total daily mileage that was 27 percent less than the combined total of the current LOGAIR and QUICKTRANS systems. Finally, the combined model was comprised of 8 fewer locations than the current LOGAIR and QUICKTRANS systems and this combined with the reduced mileage equated to approximately 30 million dollars savings per year.

V. Conclusions and Recommendations

Overview

The purpose of this chapter is to provide conclusions based upon the results of the research effort and to provide insight into where or what type of research efforts should proceed from this effort.

Conclusions

There appear to be no significant impediments to merging the LOGAIR and QUICKTRANS systems into a single combined system. Both systems are historically linked to providing priority movement of spares in support of the services first-line weapon systems within the DTS and are commonly governed by DOD Directive 4500.32R, Military Standard Transportation and Movement Procedures. Any unique operating characteristics, of either system, are not impediments to merging as evidenced by the existing common route structure, LOGAIR 5Q, in Florida. Finally, the author's combined routing model indicates there are sufficient opportunities for rationalization and inherent capacity excesses, in both systems, to realize over 30 million dollars savings per year.

Limitations of Study

As indicated in chapter one, this research effort was bounded by the limitations of the LOGAIR and QUICKTRANS

cargo systems. Additionally, it was bounded by the ready availability of data. This was a direct result of research time constraints and not a result of the willingness or research participation by LOGAIR and QUICKTRANS personnel, which was exceptional. Finally, the research was arguably parochial in nature, since it was narrowed in scope to several limited topics. However, this too was also a direct result of research time constraints.

The limits imposed focused the research on existing policies and procedures that have established the current LOGAIR and QUICKTRANS route structures. Time constraints did not allow research into topics like cargo origination points, vehicle and mode substitution, or augmentation by civilian industry. These topics may have resulted in radically different route structures yielding additional benefits in time or money.

Recommendations

The results of this research and the budgetary need for economies within the military structure indicate that there are sufficient opportunities for further study. Further research into related topics and corollary topics are areas of relevance. Additionally, the results of this effort provide sufficient stimulus to support the need for a policy reassessment on the separate LOGAIR and QUICKTRANS systems.

Additional research incorporating the inter-locational cargo data for QUICKTRANS along with additional emphasis on

route structure focusing on the economies of surface transport versus air transport may yield further economies. Although the QUICKTRANS inter-locational cargo data was not readily available for this effort, the new on-line QUICKTRANS computer system is advertised to deliver the required data much more readily (Bryan, 1990).

Throughout this effort, the author's interest was continually attracted by the common historical origins for the QUICKTRANS and LOGAIR systems. Both systems were created because there was not a dependable peacetime commercial air cargo carrier or carriers that had the capability to provide the service required during the early 1950's (Kipp, 1956:v-vi and Coon, 1986:20-21). Since the 1950's, the services offered and the capabilities of the commercial air cargo carriers have increased significantly. Research focusing on the whether the current contract cargo system is economically viable or if there is still a valid need for dedicated air transport, considering the commercial cargo capabilities, for the military services should be explored.

Finally, the commonality of goals and governance complemented by the economies highlighted by this research effort should provide a renewed emphasis for a policy review on the need for the separate LOGAIR and QUICKTRANS systems. Without a doubt, numerous assertions exist on the need for separate cargo systems. However, the capability for either system to benefit from the inherent excess capacity of both

systems exist. Reluctance to at least review the possibility while presented with reduced military budgets may not be an acceptable option. The alternative could be a complete loss of the current dedicated system, favoring instead the increased capacity and services of the deregulated cargo industry.

Appendix A: Location and Cargo Information

LOGAIR Stations

Provides destination and origin cargo tonnages for FY 89.

CODE	BASE	DESTIN CARGO	ORIGIN CARGO	LAT	LONG
ABQ	KIRTLAND	169.20	102.90	35.02	106.36
AEX	ENGLAND	144.80	81.50	31.20	92.33
BAD	BARKSDALE	586.90	106.60	32.30	93.40
BIK	KEESLER	264.90	233.30	30.25	88.55
BYH	IRA EAKER	242.40	298.10	35.58	89.57
CBM	COLUMBUS MS	163.40	104.00	33.39	88.27
CHS	CHARLESTON	1094.30	959.40	32.54	80.02
COF	PATRICK	189.10	99.40	28.14	80.36
CVS	CANNON	277.50	223.90	34.23	103.19
DLH	DULUTH	95.80	46.90	46.50	92.11
DMA	DAVIS-MONTHAM	469.00	574.80	32.10	110.53
DOV	DOVER	1476.60	1178.40	39.08	75.28
DYS	DYESS	471.60	199.00	32.25	99.51
FEW	FRANCIS E.W.	442.30	346.70	41.08	104.52
FFO	WRIGHT-PATTERSON	2713.20	3733.80	39.49	84.03
FWH	CARSWELL	662.30	474.10	32.46	97.26
GFA	MALMSTROM	552.60	402.70	47.30	111.11
GSB	SEYMOUR JOHNSON	653.30	487.60	35.20	77.58
GUS	GRISSOM	16.40	0.00	40.39	86.09
HIF	HILL	4910.50	8525.90	41.08	111.58
HMN	HOLLOMAN	624.30	498.40	32.51	106.06
HST	HOMESTEAD	469.40	452.80	25.29	80.23
IAB	MCCONNELL	399.70	279.80	37.37	97.16
LFI	LANGLEY	665.20	459.30	37.05	76.22
LIZ	LORING	366.30	476.60	46.57	67.53
LRF	LITTLE ROCK	622.80	291.50	34.55	92.09
LSV	NELLIS	537.60	372.10	36.14	115.02
LUF	LUKE	749.00	242.40	33.32	112.23
MCC	MCCLELLAN	4181.40	5146.40	38.40	121.24
MCF	MACDILL	318.00	286.60	27.51	82.31
MEM	MEMPHIS	109.40	627.80	35.03	89.59
MIB	MINOT	535.50	326.40	48.25	101.21
MTC	SELFREDGE	163.60	112.30	42.36	82.50
MUO	MOUNTAIN HOME	362.20	274.60	43.03	115.52
NIP	JACKSONVILLE	307.30	213.20	30.14	81.40
NKO	NEWARK	23.20	0.00	40.04	82.24
NQX	KEY WEST	16.40	3.10	24.34	81.41
OFF	OFFUTT	419.60	237.40	41.07	95.55
OSC	WURTSMITH	332.40	354.90	44.27	83.24
PAM	TYNDALL	353.90	323.00	30.04	85.35
PBG	PLATTSBURGH	567.30	450.20	44.39	73.28

PSM PEASE	652.20	493.80	43.04	70.49
RCA ELLSWORTH	679.00	663.70	44.09	103.06
RDR GRAND FORKS	442.30	315.60	47.57	97.24
RME GRIFFISS	514.60	469.30	43.14	75.24
SAW K.I. SAWYER	275.10	213.10	46.21	87.23
SBD NORTON	2368.00	1872.00	34.06	117.14
SKA FAIRCHILD	336.60	290.90	47.37	117.39
SKF KELLY	5832.50	6936.40	29.23	98.35
SSC SHAW	630.50	503.40	33.58	80.28
SUU TRAVIS	2108.90	1455.50	38.16	121.56
SZL WHITEMAN	314.30	223.30	38.44	93.33
TCM MCCORD	1351.60	1052.40	47.08	122.28
TIK TINKER	6261.20	5134.00	35.25	97.23
VAD MOODY	295.20	240.10	30.58	83.12
VPS EGLIN	946.90	754.90	30.29	86.32
WRB ROBINS	4135.60	5202.60	32.38	83.35
WRI MCGUIRE	1548.70	990.00	40.01	74.35

QUICKTRANS Stations

Provides destination and origin cargo tonnages for FY 89.

CODE	BASE	DESTIN CARGO	ORIGIN CARGO	LAT	LONG
CHS	CHARLESTON, SC	3234.40	3560.30	32.53	80.02
COF	CAPE CANAVERAL,	198.72	179.70	28.14	80.36
DAG	DAHLGREN, VA	200.00	200.00	38.20	77.03
DCA	WASHINGTON, DC	661.50	985.40	38.51	77.00
GON	NEW LONDON, CT	801.90	829.20	41.21	72.07
IND	WEIR COOK AP, IN	754.70	597.70	39.43	86.16
INH	INDIAN HEAD, MD	200.00	200.00	38.30	77.03
KBY	KINGS BAY, GA	257.00	0.00	30.48	81.40
LGB	LONG BEACH, CA	1939.20	894.30	33.45	118.14
NCO	NEWPORT, RI	276.40	130.20	41.28	71.20
NFL	FALLON, NV	242.60	210.90	39.28	118.47
NGU	NORFOLK, VA	9741.40	10999.80	36.57	76.18
NGZ	OAKLAND, CA	770.70	681.70	37.47	122.13
NHK	PATUXENT RIVER,	848.40	875.00	38.17	76.25
NIP	JACKSONVILLE, FL	3748.70	3750.10	30.14	81.40
NKT	CHERRY POINT, NC	1799.90	2265.40	34.54	76.54
NLC	LEMOORE, CA	594.10	913.50	36.15	119.57
NPA	PENSOCOLA, FL	1935.80	1756.60	30.21	87.19
NQX	KEY WEST, FL	305.60	284.90	24.34	81.41
NTD	NAS POINT MUGU	655.60	1127.80	34.07	119.07
NUW	WHIDBEY ISLAND,	730.10	841.50	48.17	122.37
NZJ	EL TORO, CA	100.00	100.00	33.36	117.40
NZY	SAN DIEGO, CA	7313.20	6584.40	32.42	117.12
PHL	PHILADELPHIA-1,	650.00	504.60	39.57	75.07
PNE	PHILADELPHIA-2,	48.60	327.70	39.57	75.07
PWT	BREMERTON, WA	1005.60	1823.60	47.34	122.38
SBD	SAN BERNADINO, CA	585.10	1439.60	34.06	117.17
SUU	TRAVIS AFB, CA	7043.40	5488.00	38.16	121.56
TCM	MCCHORD AFB, WA	1313.30	1169.00	47.08	122.28
TWH	NAVAL SHIPYARD,	214.40	377.70	36.49	76.18
WRI	MCCUIRE AFB	363.30	448.80	40.01	74.36

Combined Stations

Provides destination and origin cargo tonnages for FY 89.

CODE	BASE	DESTIN CARGO	ORIGIN CARGO	LAT	LONG
ABQ	KIRTLAND	169.20	102.90	35.02	106.36
AEX	ENGLAND	144.80	81.50	31.20	92.33
BAD	BARKSDALE	586.90	106.60	32.30	93.40
BIX	KEESLER	264.90	233.30	30.25	88.55
BYH	IRA EAKER	242.40	298.10	35.58	89.57
CBM	COLUMBUS MS	163.40	104.00	33.39	88.27
CHS	CHARLESTON	4328.70	4519.70	32.54	80.02
COF	PATRICK	387.82	279.10	28.14	80.36
CVS	CANNON	277.50	223.90	34.23	103.19
DAG	DAHLGREN, VA	200.00	200.00	38.20	77.03
DCA	WASHINGTON, DC	661.50	985.40	38.51	77.00
DLH	DULUTH	95.80	46.90	46.50	92.11
DMA	DAVIS-MONTHAM	469.00	574.80	32.10	110.53
DOV	DOVER	1476.60	1178.40	39.08	75.28
DYS	DYESS	471.60	199.00	32.25	99.51
FEW	FRANCIS E.W.	442.30	346.70	41.08	104.52
FFO	WRIGHT-PATTERSON	2713.20	3733.80	39.49	84.03
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HIF	HILL	4910.50	8525.90	41.08	111.58
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MUO	MOUNTAIN HOME	362.20	274.60	43.03	115.52
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NGU	NORFOLK, VA	9741.40	10999.80	36.57	76.18
NGZ	OAKLAND, CA	770.70	681.70	37.47	122.13
NHK	PATUXENT RIVER,	848.40	875.00	38.17	76.25

NIP JACKSONVILLE, FL	4056.00	3963.30	30.14	81.40
NKO NEWARK	23.20	0.00	40.04	82.24
NKT CHERRY POINT, NC	1799.90	2265.40	34.54	76.54
NLC LEMOORE, CA	594.10	913.50	36.15	119.57
NPA PENSOCOLA, FL	1935.80	1756.60	30.21	87.19
NQX KEY WEST	322.00	208.00	24.34	81.41
NTD NAS POINT MUGU	655.60	1127.80	34.07	119.07
NUW WHIDBEY ISLAND,	730.10	841.50	48.17	122.37
NZJ EL TORO, CA	100.00	100.00	33.36	117.40
NZY SAN DIEGO, CA	7313.20	6584.40	32.42	117.12
OFF OFFUTT	419.60	237.40	41.07	95.55
OSC WURTSMITH	332.40	354.90	44.27	83.24
PAM TYNDALL	353.90	323.00	30.04	85.35
PBG PLATTSBURGH	567.30	450.20	44.39	73.28
PHL PHILADELPHIA-1,	650.00	504.60	39.57	75.07
PNE PHILADELPHIA-2,	48.60	327.70	39.57	75.07
PSM PEASE	652.20	493.80	43.04	70.49
PWT BREMERTON, WA	1005.60	1823.60	47.34	122.38
RCA ELLSWORTH	679.00	663.70	44.09	103.06
RDR GRAND FORKS	442.30	315.60	47.57	97.24
RME GRIFFISS	514.60	469.30	43.14	75.24
SAW K.I. SAWYER	275.10	213.10	46.21	87.23
SBD NORTON	2953.10	3311.60	34.06	117.14
SKA FAIRCHILD	336.60	290.90	47.37	117.39
SKF KELLY	5832.50	6936.40	29.23	98.35
SSC SHAW	630.50	503.40	33.58	80.28
SUU TRAVIS	9152.30	6943.50	38.16	121.56
SZL WHITEMAN	314.30	223.30	38.44	93.33
TCM MCCHORD AFB, WA	2664.90	2221.40	47.08	122.28
TIK TINKER	6261.20	5134.00	35.25	97.23
TWH NAVAL SHIPYARD,	214.40	377.70	36.49	76.18
VAD MOODY	295.20	240.10	30.58	83.12
VPS EGLIN	946.90	754.90	30.29	86.32
WRB ROBINS	4135.60	5202.60	32.38	83.35
WRI MCGUIRE	1912.00	1438.80	40.01	74.35

Appendix B: Aircraft Operating Characteristics

L-188 C/F (1 dr)

PAYLOAD - 34,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

Palletized Volume	3,139 cubic feet
Dimensions	68'9" L x 9'6" W x 7'3" H
Floor Area	652 square feet
Forward Cargo Door (Front Loading)	90" H x 140" W
Aft Cargo Door (Rear Loading)	80" H x 142" W
Floor Height Above Ground	102" Forward - 110" Aft
Cruising Speed	350 MPH

L-188 C/F (2 dr)

PAYLOAD - 34,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

Palletized Volume	3,139 cubic feet
Dimensions	68'9" L x 9'6" W x 7'3" H
Floor Area	652 square feet
Forward Cargo Door (Front Loading)	90" H x 140" W
Aft Cargo Door (Rear Loading)	80" H x 98" W
Floor Height Above Ground	102" Forward - 110" Aft
Cruising Speed	350 MPH

L-100-30

PAYLOAD - 46,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

Palletized Volume	4,356 cubic feet
Dimensions	55'9" L x 10' W x 9' H
Floor Area	675 square feet
Cargo Door Dimension	120" H x 108" W
Floor Height Above Ground	41"
Cruising Speed	326 MPH

B-727-100C

PAYLOAD - 34,000 lbs (contract) 44,400 lbs (capability)

MAIN CARGO COMPARTMENT:

Palletized Volume	2,800 cubic feet*
Dimensions	72'8"L x 11'7" W x 7'2" H
Floor Area	851 square feet
Cargo Door Dimension	84" H x 134" W
Floor Height Above Ground	117"
Cruising Speed	525 MPH

*When 16 54 x 88 pallet configuration is used.

DC-9-30

PAYLOAD - 34,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

Palletized Volume	3,151 cubic feet
Dimensions	68'6" L x 9'6" W x 6'9" H
Floor Area	650 square feet
Cargo Door Dimension	81" H x 136" W
Floor Height Above Ground	84"
Cruising Speed	540 MPH

CV-640

PAYLOAD - 18,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

Palletized Volume	2,515 cubic feet
Dimensions	48'9" L x 7'6" W x 6' H
Floor Area	399 square feet
Cargo Door Dimension	72" H x 108" W
Floor Height Above Ground	???
Cruising Speed	300 MPH

Appendix C: Planning Factors

Contract Versus ETADS Comparison

ACFT	CONTRACT TONNAGES	ETADS FACTOR	PERCENT AVAILABLE	AVG PER DAY
L-100	46,000	40,981	89.1%	5,854
L-188	34,000	28,640	84.2%	4,091
B-727	34,000	30,950	91.0%	4,421
DC-9	34,000	28,541	83.9%	4,077
CV640	18,000	15,673	87.1%	2,239
TRUCKS	24,000	N/A	100.0%	24,000

Daily Weighted Factors

L100 FACTORS		L188 FACTORS		B-727 FACTORS	
SCHEDULED CARGO DAYS	TONNAGES	SCHEDULED CARGO DAYS	TONNAGES	SCHEDULED CARGO DAYS	TONNAGES
1	5,854	1	4,091	1	4,421
2	11,709	2	8,183	2	8,843
3	17,563	3	12,274	3	13,264
4	23,418	4	16,366	4	17,686
5	29,272	5	20,457	5	22,107
6	35,127	6	24,549	6	26,529
7	40,981	7	28,640	7	30,950

DC-9 FACTORS		CV640 FACTORS	
SCHEDULED CARGO DAYS	TONNAGES	SCHEDULED CARGO DAYS	TONNAGES
1	4,077	1	2,239
2	8,155	2	4,478
3	12,232	3	6,717
4	16,309	4	8,956
5	20,386	5	11,195
6	24,464	6	13,434
7	28,541	7	15,673

Cruising Speeds (MPH)

CV640	300
L-188	350
L-100	326
B-727	525
DC-9	540

Taxiing Times (Minutes)

AFTER LANDING	20
BEFORE TAKEOFF	20

Standard Ground Times

Aircraft Type	Base	Ground Time if	
		Normal Ground Time	Designated Resequencing Station
2 dr L-188, Dc-9	Mission	0 plus 45	1 plus 00
	ALC/APOE	1 plus 30	1 plus 45
1 dr (FWD) L-188	Mission	1 plus 00	1 plus 15
	ALC/APOE	1 plus 45	2 plus 00
L-100-30	Mission	1 plus 00	1 plus 15
	ALC/APOE	1 plus 30	1 plus 45

Truck Data

MILEAGE = 120% of Euclidean Statute Miles

HOURS = Normally restricted to 8-10 driving
(Dual drivers can double the effective driving times)

SPEED = 40-45 MPH

Appendix D: Cost Factors

LOGAIR Costs Factors

FY89 Mile/Tonmiles

	miles	tonmiles
OCT 88	968,406	9,158,125.30
NOV	898,496	8,648,226.18
DEC	902,419	8,650,707.91
JAN 89	943,017	8,781,158.29
FEB	882,445	8,467,527.52
MAR	1,036,694	10,090,506.25
APR	981,209	9,693,873.65
MAY	1,004,928	9,621,481.08
JUN	993,968	9,278,913.67
JUL	949,211	8,810,794.75
AUG	1,042,153	9,668,373.10
SEP 89	999,524	9,126,746.62

TOTAL	11,602,470	109,996,434.32
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FY89 Costs

Miles	\$64,413,711.37
Taxes(est)	\$2,977,389.51
Landings	\$1,750,500.00
fuel	\$16,691,328.93
Total	\$85,832,929.81

\$\$ / ton	\$795.63929
\$\$ / pound	\$0.39782
\$\$ / tonmile	\$0.78032
\$\$ / lb-mile	\$0.0003901623

\$ per mile	\$7.3978
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QUICKTRANS Cost Factors

1. MONTHLY COSTS FOR QUICKTRANS SERVICE

MONTH	AIR CARRIER COST	TERMINAL CONTRACTOR COST	TRUCK CARRIER COST	SYSTEMS DEVELOPMENT COST
OCT 88	\$2,233,565.67	\$1,008,761.08	\$263,033.41	
NOV 88	\$2,173,988.42	\$976,220.40	\$263,529.48	
DEC 88	\$2,118,160.99	\$1,008,761.08	\$258,805.00	
JAN 89	\$2,066,409.23	\$1,008,761.08	\$219,657.84	
FEB 89	\$1,957,549.87	\$911,139.04	\$232,256.14	
MAR 89	\$2,203,177.64	\$1,008,761.08	\$280,605.69	
APR 89	\$2,160,235.16	\$976,222.40	\$244,350.41	\$60,000.00
MAY 89	\$2,133,852.72	\$1,008,761.08	\$254,914.43	
JUN 89	\$2,140,617.89	\$976,222.40	\$252,922.20	\$50,000.00
JUL 89	\$2,130,228.34	\$1,008,761.08	\$230,213.30	\$50,000.00
AUG 89	\$2,202,360.91	\$1,008,761.08	\$275,674.92	\$50,000.00
SEP 89	\$2,072,590.52	\$976,222.40	\$228,592.54	\$69,244.00
TOTAL	\$25,592,737.36	\$11,877,354.20	\$3,004,555.36	\$279,244.00

TOTAL COSTS: \$40,753,890.92

Common Aircraft Cost Factors

Each aircraft contractor is paid for number of Great Circle Statute Miles (GCSMs) that the cargo is transported and for directed landings. The following is an extract from the applicable contracts for LOGAIR and QUICKTRANS:

Contract Number:	F11626-90-D0022 (QUICKTRANS)
Contractor's Name:	Southern Air Transport, Inc
Type Aircraft:	L-100-30
Dollars per GCSM Rate:	\$7.3305
Dollars per Landing:	\$250.00
Contract Number:	F11626-90-D0023 (LOGAIR)
Contractor's Name:	Southern Air Transport, Inc
Type Aircraft:	L-100-30
Dollars per GCSM Rate:	\$7.1963
Dollars per Landing:	\$250.00
Contract Number:	F11626-90-D0030 (LOGAIR)
Contractor's Name:	Evergreen International Airlines
Type Aircraft:	B-727-100 DC-9-30
Dollars per GCSM Rate:	\$5.558
(Depends on Route)	\$5.514 \$5.558
Dollars per Landing:	N/A
Contract Number:	F11626-90-D0031 (LOGAIR)
Contractor's Name:	TPI International Airways, Inc
Type Aircraft:	L-188
Dollars per GCSM Rate:	\$5.402
Dollars per Landing:	N/A
Contract Number:	F11626-90-D0032 (LOGAIR)
Contractor's Name:	Zantop International Airlines
Type Aircraft:	L-188
Dollars per GCSM Rate:	\$6.1181
Dollars per Landing:	N/A
Contract Number:	F11626-90-D0059 (LOGAIR)
Contractor's Name:	Zantop International Airlines
Type Aircraft:	CV-640
Dollars per GCSM Rate:	\$5.3499
Dollars per Landing:	N/A

Appendix E: Two-Dimensional Spacefilling Results

QUICKTRANS Locations Sorted by Theta

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

RANK	CODE	LOCATION	LONG	LAT	THETA
1	COF	CAPE CANAVERAL, FL	28.14	80.36	0.007813
2	NQX	KEY WEST FL	24.34	81.41	0.015625
3	NIP	JACKSONVILLE FL	30.14	81.40	0.019531
4	KBY	KINGS BAY GA	30.48	81.40	0.019531
5	CHS	CHARLESTON SC	32.53	80.02	0.023438
6	NPA	PENSOCOLA FL	30.21	87.19	0.042969
7	IND	WEIR COOK AP IN	39.43	86.16	0.093750
8	NZY	SAN DIEGO CA	32.42	117.12	0.257813
9	NZJ	EL TORO CA	33.36	117.40	0.257813
10	LGB	LONG BEACH CA	33.45	118.14	0.257813
11	NLC	LEMOORE CA	36.15	119.57	0.265625
12	SBD	SAN BERNADINO CA	34.06	117.17	0.269531
13	NTD	NAS POINT MUGU	34.07	119.07	0.269531
14	NFL	FALLON NV	39.28	118.47	0.292969
15	NGZ	OAKLAND CA	37.47	122.13	0.296875
16	SUU	TRAVIS AFB CA	38.16	121.56	0.296875
17	PWT	BREMERTON WA	47.34	122.38	0.312500
18	NUW	WHIDBEY ISLAND WA	48.17	122.37	0.312500
19	TCM	MCCHORD AFB WA	47.08	122.28	0.312500
20	NCO	NEWPORT RI	41.28	71.20	0.949219
21	GON	NEW LONDON CT	41.21	72.07	0.949219
22	WRI	MCGUIRE AFB	40.01	74.36	0.953125
23	INH	INDIAN HEAD MD	38.30	77.03	0.957031
24	NHK	PATUXENT RIVER MD	38.17	76.25	0.957031
25	PNE	PHILADELPHIA-2 PA	39.57	75.07	0.957031
26	PHL	PHILADELPHIA-1 PA	39.57	75.07	0.957031
27	DAG	DAHLGREN VA	38.20	77.03	0.957031
28	DCA	WASHINGTON DC	38.51	77.00	0.957031
29	TWH	NAVAL SHIPYARD VA	36.49	76.18	0.980469
30	NGU	NORFOLK VA	36.57	76.18	0.980469
31	NKT	CHERRY POINT NC	34.54	76.54	0.980469

[illegible]

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LOGAIR Locations Sorted by Theta

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

RANK	CODE	LOCATION	LONG	LAT	THETA
1	HST	HOMESTEAD	25.29	80.23	0.015625
2	COF	PATRICK	28.14	80.36	0.019531
3	CHS	CHARLESTON	32.54	80.02	0.027344
4	SSC	SHAW	33.58	80.28	0.027344
5	WRB	ROBINS	32.38	83.35	0.035156
6	VPS	EGLIN	30.29	86.32	0.039063
7	PAM	TYNDALL	30.04	85.35	0.039063
8	NIP	JACKSONVILLE	30.14	81.40	0.042969
9	VAD	MOODY	30.58	83.12	0.042969
10	MCF	MACDILL	27.51	82.31	0.046875
11	NQX	KEY WEST	24.34	81.41	0.046875
12	BIX	KEESLER	30.25	88.55	0.054688
13	CBM	COLUMBUS MS	33.39	88.27	0.070313
14	BAD	BARKSDALE	32.30	93.40	0.074219
15	AEX	ENGLAND	31.20	92.33	0.074219
16	LRF	LITTLE ROCK	34.55	92.09	0.074219
17	BYH	IRA EAKER	35.58	89.57	0.082031
18	MEM	MEMPHIS	35.03	89.59	0.082031
19	FFO	WRIGHT-PATTERSON	39.49	84.03	0.093750
20	NKO	NEWARK	40.04	82.24	0.093750
21	GUS	GRISSOM	40.39	86.09	0.097656
22	SZL	WHITEMAN	38.44	93.33	0.109375
23	DLH	DULUTH	46.50	92.11	0.121094
24	RDR	GRAND FORKS	47.57	97.24	0.128906
25	OFF	OFFUTT	41.07	95.55	0.140625
26	RCA	ELLSWORTH	44.09	103.06	0.148438
27	FEW	FRANCIS E.W.	41.08	104.52	0.152344
28	ABQ	KIRTLAND	35.02	106.36	0.156250
29	DYS	DYESS	32.25	99.51	0.164063
30	TIK	TINKER	35.25	97.23	0.171875
31	IAB	MCCONNELL	37.37	97.16	0.171875
32	FWH	CARSWELL	32.46	97.26	0.175781
33	SKF	KELLY	29.23	98.35	0.183594
34	CVS	CANNON	34.23	103.19	0.210938
35	HMN	HOLLOMAN	32.51	106.06	0.214844
36	DMA	DAVIS-MONTHAM	32.10	110.53	0.222656
37	SBD	NORTON	34.06	117.14	0.257813
38	LUF	LUKE	33.32	112.23	0.273438
39	LSV	NELLIS	36.14	115.02	0.277344
40	HIF	HILL	41.08	111.58	0.281250
41	MCC	MCCLELLAN	38.40	121.24	0.296875
42	SUU	TRAVIS	38.16	121.56	0.296875
43	SKA	FAIRCHILD	47.37	117.39	0.304688
44	TCM	MCCHORD	47.08	122.28	0.308594
45	GFA	MALMSTROM	47.30	111.11	0.332031
46	MUO	MOUNTAIN HOME	43.03	115.52	0.335938

47	MIB	MINOT	48.25	101.21	0.367188
48	SAW	K.I. SAWYER	46.21	87.23	0.882813
49	OSC	WURTSMITH	44.27	83.24	0.902344
50	MTC	SELFRIDGE	42.36	82.50	0.902344
51	LIZ	LORING	46.57	67.53	0.941406
52	PBG	PLATTSBURGH	44.39	73.28	0.945313
53	PSM	PEASE	43.04	70.49	0.949219
54	WRI	MCGUIRE	40.01	74.35	0.957031
55	RME	GRIFFISS	43.14	75.24	0.960938
56	DOV	DOVER	39.08	75.28	0.964844
57	LFI	LANGLEY	37.05	76.22	0.972656
58	GSB	SEYMOUR JOHNSON	35.20	77.58	0.972656

SFC TWO DIMENSIONAL GROUPINGS LOGAIR LOCATIONS

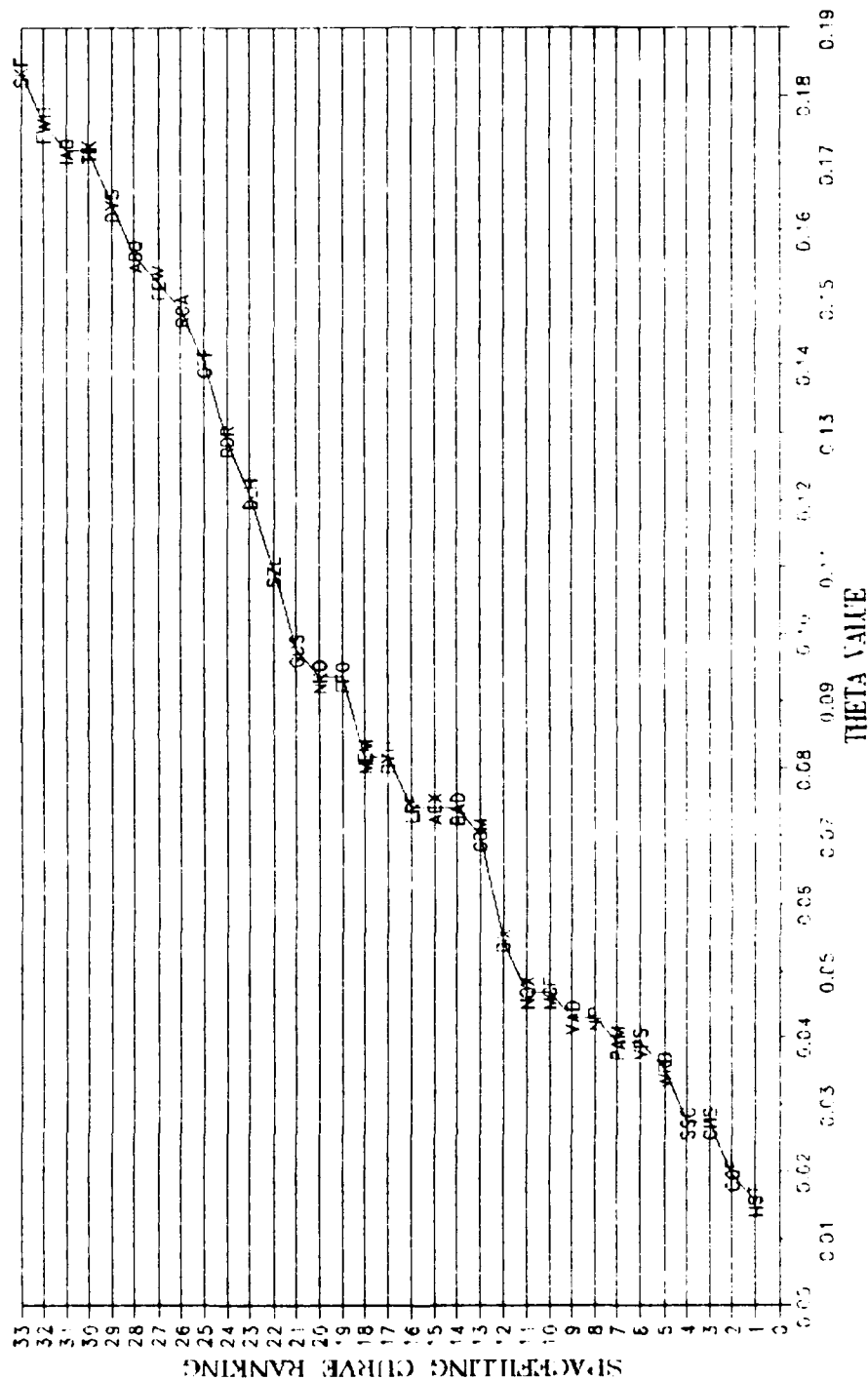


Figure 13: Partial LOGAIR Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

SFC TWO DIMENSIONAL GROUPINGS LOGAIR LOCATIONS

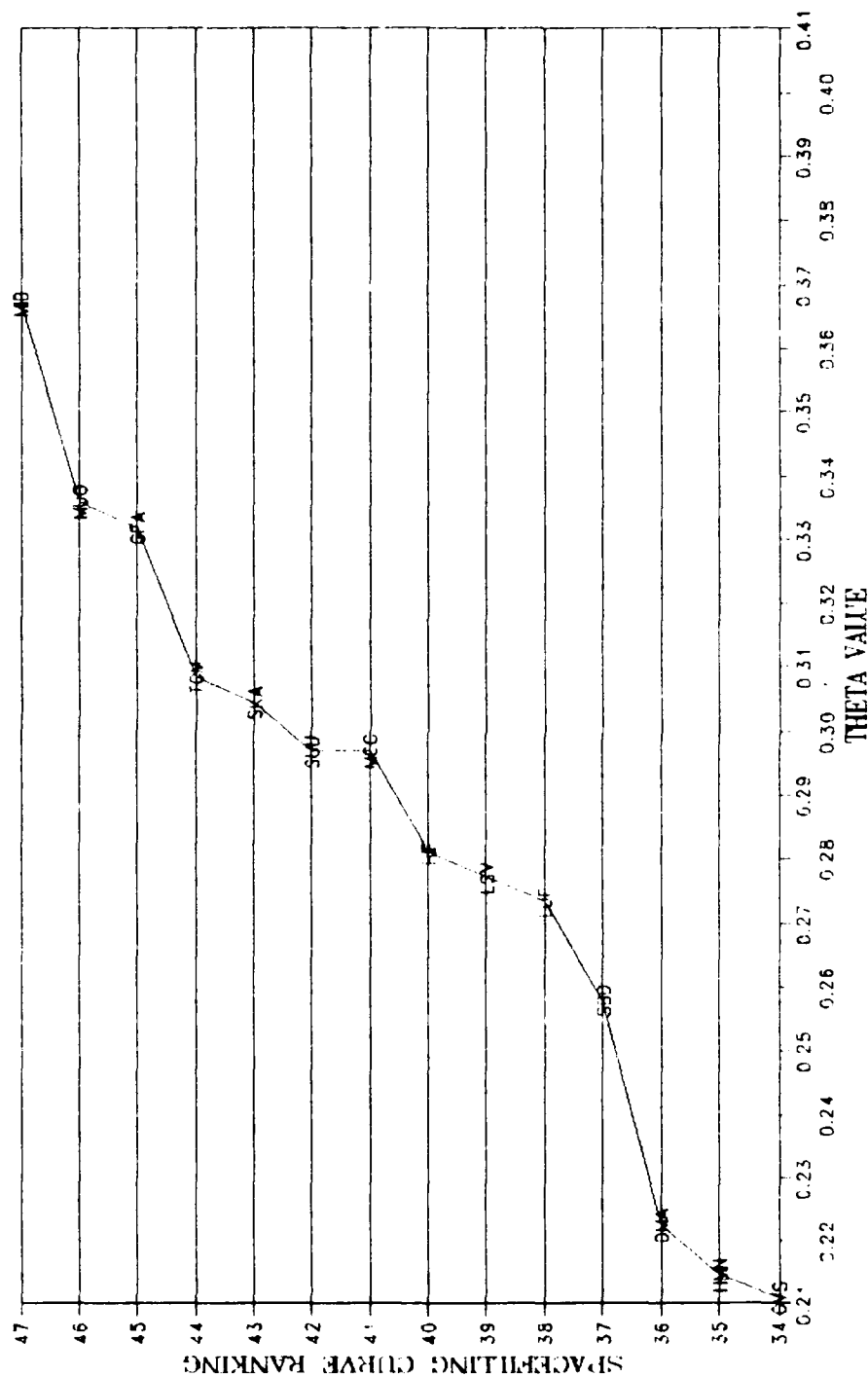


Figure 14: Partial LOGAIR Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

Theta Value	SAA	MTC	GSC	L2	DGC	DGM	W6	RME	DGV	J1
0.88	48.5									
0.90	50.5	50.5								
0.94				51.5	52.0	53.0				
0.97							54.0	55.0	56.0	57.5

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Combined Model Locations Sorted by Theta

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

RANK	CODE	LOCATION	LONG	LAT	THETA
1	HST	HOMESTEAD	25.29	80.23	0.015625
2	COF	PATRICK	28.14	80.36	0.019531
3	NKT	CHERRY POINT	34.54	76.54	0.023438
4	SSC	SHAW	33.58	80.28	0.027344
5	CHS	CHARLESTON	32.54	80.02	0.027344
6	WRB	ROBINS	32.38	83.35	0.035156
7	VPS	EGLIN	30.29	86.32	0.039063
8	PAM	TYNDALL	30.04	85.35	0.039063
9	NPA	PENSOCOLA	30.21	87.19	0.039063
10	VAD	MOODY	30.58	83.12	0.042969
11	NIP	JACKSONVILLE	30.14	81.40	0.042969
12	KBY	KINGS BAY	30.48	81.40	0.042969
13	NQX	KEY WEST	24.34	81.41	0.046875
14	MCF	MACDILL	27.51	82.31	0.046875
15	BIX	KEESLER	30.25	88.55	0.054688
16	AEX	ENGLAND	31.20	92.33	0.066406
17	CBM	COLUMBUS MS	33.39	88.27	0.070313
18	BAD	BARKSDALE	32.30	93.40	0.074219
19	LRF	LITTLE ROCK	34.55	92.09	0.074219
20	BYH	IRA EAKER	35.58	89.57	0.082031
21	MEM	MEMPHIS	35.03	89.59	0.082031
22	NKO	NEWARK	40.04	82.24	0.093750
23	FFO	WRIGHT-PATTERSON	39.49	84.03	0.093750
24	GUS	GRISSOM	40.39	86.09	0.097656
25	IND	WEIR COOK AP	39.43	86.16	0.097656
26	SZL	WHITEMAN	38.44	93.33	0.109375
27	DLH	DULUTH	46.50	92.11	0.121094
28	RDR	GRAND FORKS	47.57	97.24	0.128906
29	OFF	OFFUTT	41.07	95.55	0.140625
30	RCA	ELLSWORTH	44.09	103.06	0.148438
31	FEW	FRANCIS E.W.	41.08	104.52	0.152344
32	ABQ	KIRTLAND	35.02	106.36	0.156250
33	DYS	DYESS	32.25	99.51	0.164063
34	IAB	MCCONNELL	37.37	97.16	0.171875
35	TIK	TINKER	35.25	97.23	0.171875
36	FWH	CARSWELL	32.46	97.26	0.175781
37	SKF	KELLY	29.23	98.35	0.183594
38	CVS	CANNON	34.23	103.19	0.210938
39	HMN	HOLLOMAN	32.51	106.06	0.214844
40	DMA	DAVIS-MONTHAM	32.10	110.53	0.222656
41	LGB	LONG BEACH	33.45	118.14	0.257813
42	NZY	SAN DIEGO	32.42	117.12	0.257813
43	NZJ	EL TORO	33.36	117.40	0.257813
44	SBD	NORTON	34.06	117.14	0.257813
45	NTD	POINT MUGU	34.07	119.07	0.261719
46	NLC	LEMOORE	36.15	119.57	0.265625

47	NGZ	OAKLAND	37.47	122.13	0.265625
48	LUF	LUKE	33.32	112.23	0.273438
49	LSV	NELLIS	36.14	115.02	0.277344
50	HIF	HILL	41.08	111.58	0.281250
51	NFL	FALLON	39.28	118.47	0.292969
52	SUU	TRAVIS AFB	38.16	121.56	0.296875
53	MCC	MCCLELLAN	38.40	121.24	0.296875
54	SKA	FAIRCHILD	47.37	117.39	0.304688
55	NUW	WHIDBEY ISLAND	48.17	122.37	0.308594
56	TCM	MCCHORD AFB	47.08	122.28	0.308594
57	PWT	BREMERTON	47.34	122.38	0.308594
58	GFA	MALMSTROM	47.30	111.11	0.332031
59	MUO	MOUNTAIN HOME	43.03	115.52	0.335938
60	MIB	MINOT	48.25	101.21	0.367188
61	SAW	K.I. SAWYER	46.21	87.23	0.882813
62	OSC	WURTSMITH	44.27	83.24	0.902344
63	MTC	SELFRIIDGE	42.36	82.50	0.902344
64	LIZ	LORING	46.57	67.53	0.941406
65	PBG	PLATTSBURGH	44.39	73.28	0.945313
66	PSM	PEASE	43.04	70.49	0.949219
67	NCO	NEWPORT	41.28	71.20	0.957031
68	WRI	MCGUIRE	40.01	74.35	0.957031
69	GON	NEW LONDON	41.21	72.07	0.957031
70	RME	GRIFFISS	43.14	75.24	0.960938
71	PNE	PHILADELPHIA-2	39.57	75.07	0.964844
72	PHL	PHILADELPHIA-1	39.57	75.07	0.964844
73	INH	INDIAN HEAD	38.30	77.03	0.964844
74	DOV	DOVER	39.08	75.28	0.964844
75	NHK	PATUXENT RIVER	38.17	76.25	0.964844
76	DCA	WASHINGTON	38.51	77.00	0.964844
77	DAG	DAHLGREN	38.20	77.03	0.964844
78	LFI	LANGLEY	37.05	76.22	0.972656
79	NGU	NORFOLK	36.57	76.18	0.972656
80	GSB	SEYMOUR JOHNSON	35.20	77.58	0.972656
81	TWH	NAVAL SHIPYARD	36.49	76.18	0.972656

SFC TWO DIMENSIONAL GROUPINGS COMBINED LOCATIONS

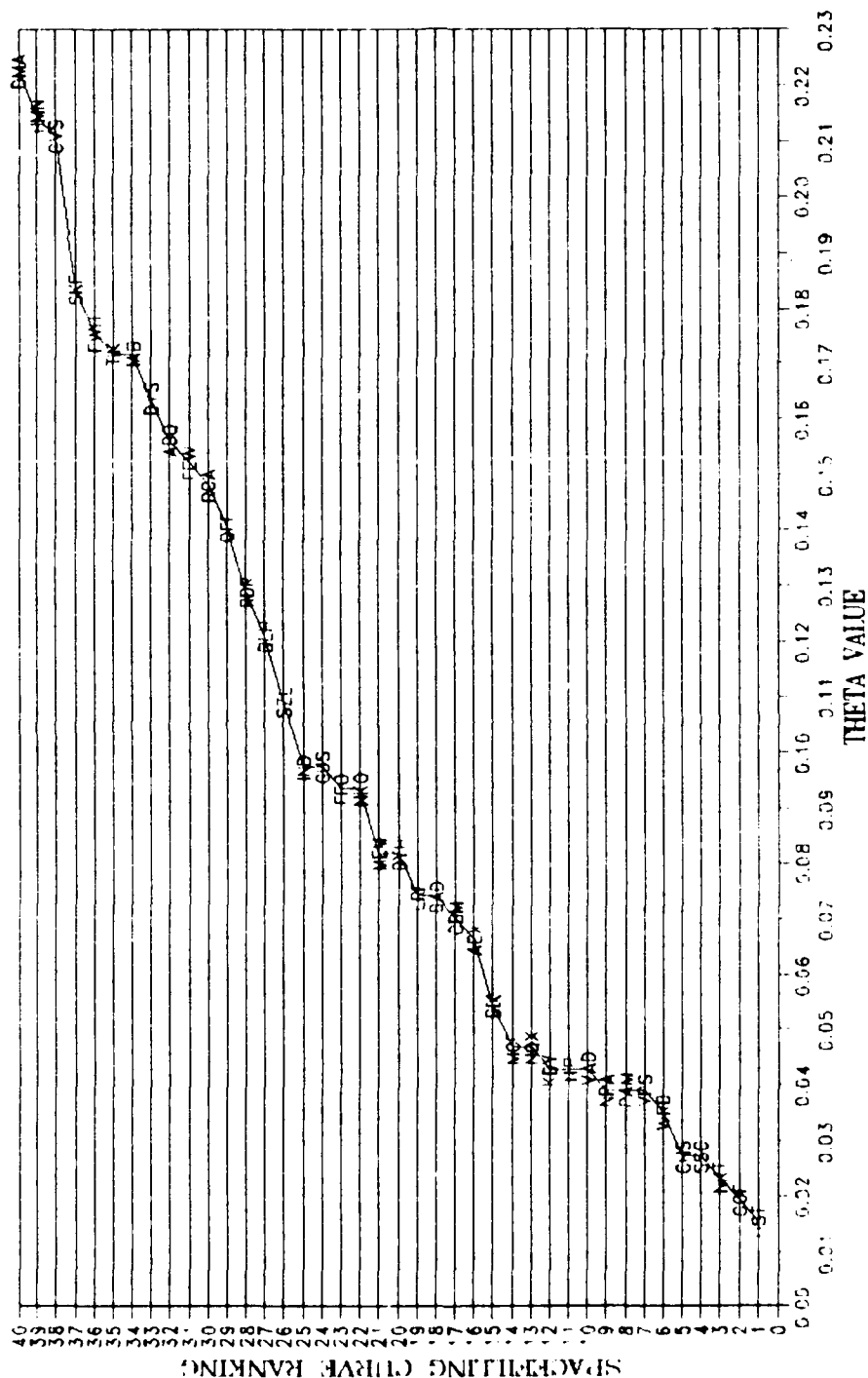


Figure 16: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

SFC TWO DIMENSIONAL GROUPINGS COMBINED LOCATIONS

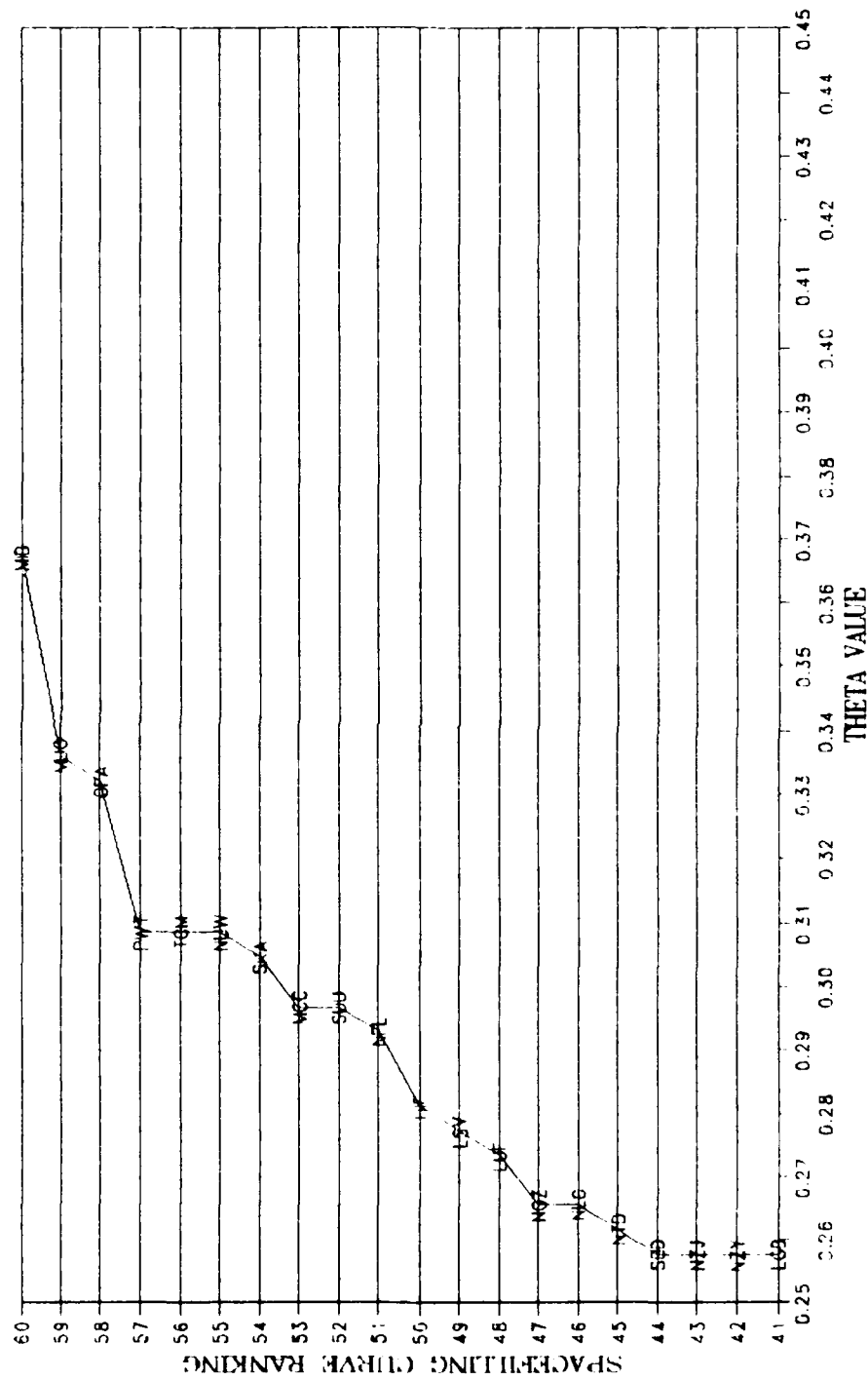


Figure 17: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

SFC TWO DIMENSIONAL GROUPINGS COMBINED LOCATIONS

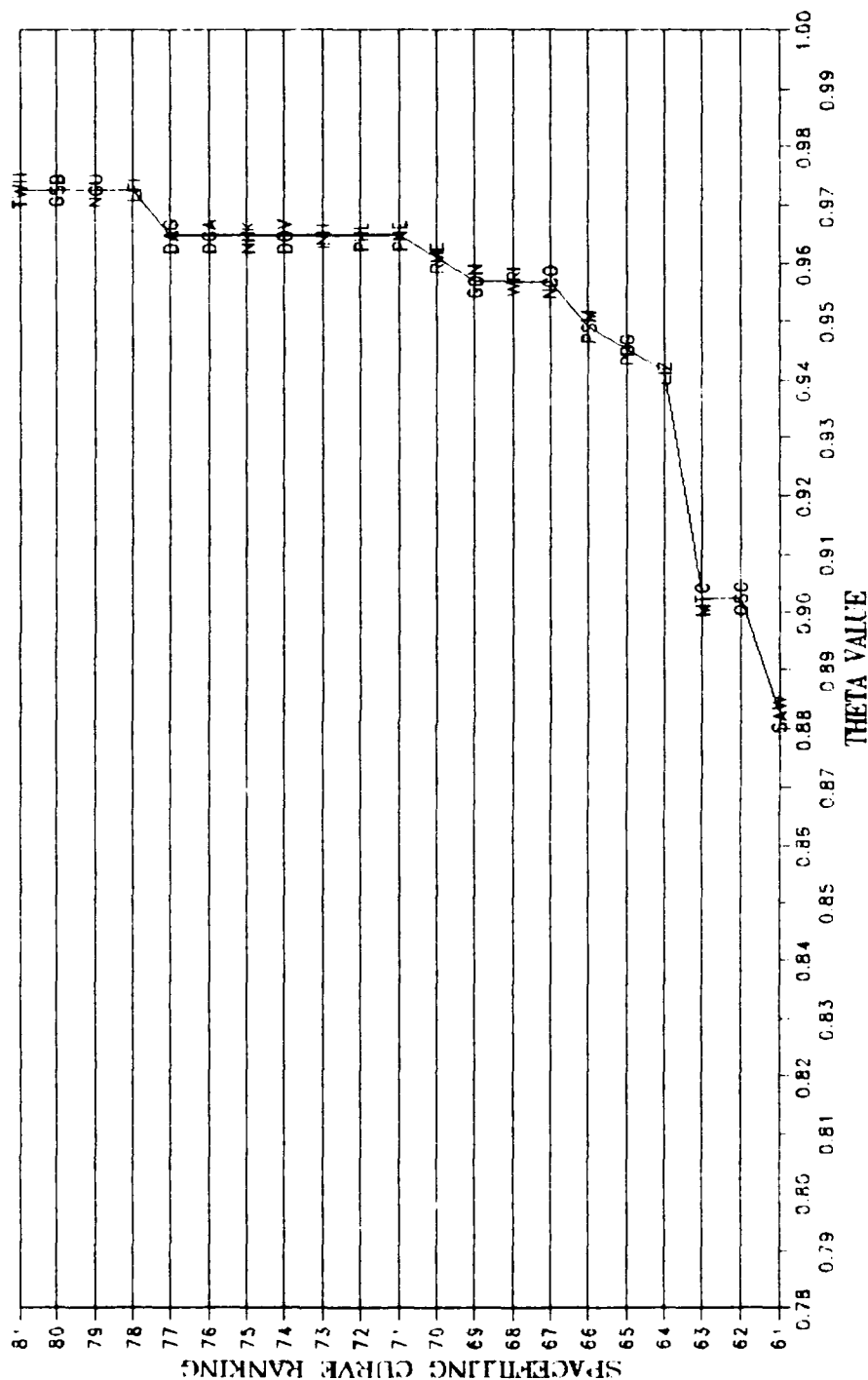


Figure 18: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

Appendix F: Three-Dimensional Spacefilling Curve Results

QUICKTRANS Destination Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	NIP JACKSONVILLE	30.14	81.4	3748.7	.015625
2	CHS CHARLESTON SC	32.53	80.02	3234.4	.015625
3	WRI MCGUIRE AFB	40.01	74.36	363.3	.03125
4	COF CAPE CANAVERAL	28.14	80.36	198.72	.03125
5	IND WEIR COOK AP	39.43	86.16	754.7	.03125
6	DAHLGREN VA	38.2	77.03	200	.03125
7	LGB LONG BEACH CA	33.45	118.14	1939.2	.03125
8	NLC LEMOORE CA	36.15	119.57	594.1	.03125
9	NCO NEWPORT RI	41.28	71.2	276.4	.03125
10	GON NEW LONDON CT	41.21	72.07	801.9	.03125
11	PHL PHILADELPHIA-1	39.57	75.07	650	.03125
12	NGZ OAKLAND CA	37.47	122.13	770.7	.03125
13	INH INDIAN HEAD MD	38.3	77.03	200	.03125
14	TWH NAVAL SHIPYARD	36.49	76.18	214.4	.03125
15	NKT CHERRY POINT	34.54	76.54	1799.9	.03125
16	KBY KINGS BAY GA	30.48	81.4	257	.03125
17	NPA PENSOCOLA FL	30.21	87.19	1935.8	.03125
18	NOX KEY WEST FL	24.34	81.41	305.6	.03125
19	NTD NAS POINT MUGU	34.07	119.07	655.6	.03125
20	NUW WHIDBEY ISLAND	48.17	122.37	730.1	.03125
21	NZJ EL TORO CA	33.36	117.4	100	.03125
22	NFL FALLON NV	39.28	118.47	242.6	.03125
23	DCA WASHINGTON DC	38.51	77	661.5	.03125
24	PNE PHILADELPHIA-2	39.57	75.07	48.6	.03125
25	PWT BREMERTON WA	47.34	122.38	1005.6	.03125
26	SBD SAN BERNADINO	34.06	117.17	585.1	.03125
27	NHK PATUXENT RIVER	38.17	76.25	848.4	.03125
28	TCM MCCHORD AFB WA	47.08	122.28	1313.3	.03125
29	NGU NORFOLK VA	36.57	76.18	9741.40	.90625
30	SUU TRAVIS AFB CA	38.16	121.56	7043.4	.921875
31	NZY SAN DIEGO CA	32.42	117.12	7313.2	.921875

QUICKTRANS Origin Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	SUU TRAVIS AFB CA	38.16	121.56	5488	.015625
2	NIP JACKSONVILLE	30.14	81.4	3750.1	.015625
3	CHS CHARLESTON SC	32.53	80.02	3560.3	.015625
4	WRI MCGUIRE AFB	40.01	74.36	448.8	.03125
5	DAHIGREN VA	38.2	77.03	200	.03125
6	INH INDIAN HEAD MD	38.3	77.03	200	.03125
7	COP CAPE CANAVERAL	28.14	80.36	179.7	.03125
8	LGB LONG BEACH CA	33.45	118.14	894.3	.03125
9	NCO NEWPORT RI	41.28	71.2	130.2	.03125
10	GON NEW LONDON CT	41.21	72.07	829.2	.03125
11	IND WEIR COOK AP	39.43	86.16	597.7	.03125
12	NGZ OAKLAND CA	37.47	122.13	681.7	.03125
13	NHK PATUXENT RIVER	38.17	76.25	875	.03125
14	TWH NAVAL SHIPYARD	36.49	76.18	377.7	.03125
15	NLC LEMOORE CA	36.15	119.57	913.5	.03125
16	NKT CHERRY POINT	34.54	76.54	2265.1	.03125
17	NPA PENSOCOLA FL	30.21	87.19	1756.6	.03125
18	NQX KEY WEST FL	24.34	81.41	284.9	.03125
19	NTD NAS POINT MUGU	34.07	119.07	1127.8	.03125
20	NUW WHIDBEY ISLAND	48.17	122.37	841.5	.03125
21	NZJ EL TORO CA	33.36	117.4	100	.03125
22	NFL FALLON NV	39.28	118.47	210.9	.03125
23	PHL PHILADELPHIA-1	39.57	75.07	504.6	.03125
24	PNE PHILADELPHIA-2	39.57	75.07	327.7	.03125
25	PWT BREMERTON WA	47.34	122.38	1823.6	.03125
26	SBD SAN BERNADINO	34.06	117.17	1439.6	.03125
27	KBY KINGS BAY GA	30.48	81.4	0	.03125
28	TCM MCCHORD AFB WA	47.08	122.28	1169	.03125
29	DCA WASHINGTON DC	38.51	77	985.4	.03125
30	NGU NORFOLK VA	36.57	76.18	10999.8	.90625
31	NZY SAN DIEGO CA	32.42	117.12	6584.4	.921875

LOGAIR Destination Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	FPO WRIGHT-PATT	39.49	84.03	2713.2	.015625
2	SUU TRAVIS	38.16	121.56	2108.9	.015625
3	SBD NORTON	34.06	117.14	2368	.015625
4	VAD MOODY	30.58	83.12	295.2	.03125
5	VPS EGLIN	30.29	86.32	946.9	.03125
6	ABQ KIRTLAND	35.02	106.36	169.2	.03125
7	AEX ENGLAND	31.2	92.33	144.8	.03125
8	CVS CANNON	34.23	103.19	277.5	.03125
9	BYH IRA EAKER	35.58	89.57	242.4	.03125
10	DMA DAVIS-MONTHAM	32.1	110.53	469	.03125
11	CBM COLUMBUS MS	33.39	88.26	163.4	.03125
12	WRI MCGUIRE	40.01	74.35	1548.7	.03125
13	BAD BARKSDALE	32.3	93.4	586.9	.03125
14	MCP MACDILL	27.51	82.31	318	.03125
15	GFA MALMSTROM	47.3	111.11	552.6	.03125
16	MTC SELFRIDGE	42.36	82.5	163.6	.03125
17	GSB SEYMOUR JOHNSON	35.2	77.58	653.3	.03125
18	GUS GRISSOM	40.39	86.08	16.4	.03125
19	DLH DULUTH	46.5	92.11	95.8	.03125
20	HMN HOLLOMAN	32.51	106.06	624	.03125
21	HST HOMESTEAD	25.29	80.23	469.4	.03125
22	IAB MCCONNELL	37.37	97.16	399.7	.03125
23	DOV DOVER	39.08	75.28	1476.6	.03125
24	LIZ LORING	46.57	67.53	366.3	.03125
25	LRP LITTLE ROCK	34.55	92.08	622.8	.03125
26	DYS DYESS	32.25	99.51	471.6	.03125
27	FEW FRANCIS E.W.	41.08	104.52	442.3	.03125
28	CHS CHARLESTON	32.54	80.02	1094.3	.03125
29	MIB MINOT	48.25	101.21	535.5	.03125
30	MEM MEMPHIS	35.03	89.58	109.4	.03125
31	FWH CARSWELL	32.46	97.26	662.3	.03125
32	COP PATRICK	28.14	80.36	189.1	.03125
33	MUO MOUNTAIN HOME	43.03	115.52	362.2	.03125
34	NIP JACKSONVILLE	30.14	81.4	307.3	.03125
35	NKO NEWARK	40.04	82.24	23.2	.03125
36	NQX KEY WEST	24.34	81.41	16.4	.03125
37	OFF OFFUTT	41.07	95.55	419.6	.03125
38	OSC WURTSMITH	44.27	83.24	332.4	.03125
39	PAM TYNDALL	30.04	85.35	353.9	.03125
40	PBG PLATTSBURGH	44.39	73.28	567.3	.03125
41	PSM PEASE	43.04	70.49	652.2	.03125
42	RCA ELLSWORTH	44.09	103.06	679.0	.03125
43	RDR GRAND FORKS	47.57	97.24	442.3	.03125
44	RME GRIFFISS	43.14	75.24	514.6	.03125
45	SAW K.I. SAWYER	46.21	87.23	275.1	.03125
46	BIX KEESLER	30.25	88.55	264.9	.03125

47	SKA FAIRCHILD	47.37	117.39	336.6	.03125
48	LFI LANGLEY	37.05	76.22	665.2	.03125
49	SSC SHAW	33.58	80.28	630.5	.03125
50	LUF LUKE	33.32	112.23	749.0	.03125
51	SZL WHITEMAN	38.44	93.33	314.3	.03125
52	TCM MCCHORD	47.08	122.28	1351.6	.03125
53	LSV NELLIS	36.14	115.02	537.6	.03125
54	TIK TINKER	35.25	97.23	6261.2	.90625
55	SKF KELLY	29.23	98.35	5832.5	.90625
56	HIF HILL	41.08	111.58	4910.5	.90625
57	MCC MCCLELLAN	38.4	121.24	4181.4	.921875
58	WRB ROBINS	32.38	83.35	4135.6	.921875

LOGAIR Origin Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	FFO WRIGHT-PATT	39.49	84.03	3733.8	.015625
2	VAD MOODY	30.58	83.12	240.1	.03125
3	FWH CARSWELL	32.46	97.26	474.1	.03125
4	AEX ENGLAND	31.2	92.33	81.5	.03125
5	LUF LUKE	33.32	112.23	242.4	.03125
6	WRI MCGUIRE	40.01	74.35	990	.03125
7	COP PATRICK	28.14	80.36	99.4	.03125
8	CVS CANNON	34.23	103.19	223.9	.03125
9	BYH IRA EAKER	35.58	89.57	298.1	.03125
10	DMA DAVIS-MONTHAM	32.1	110.53	574.8	.03125
11	BAD BARKSDALE	32.3	93.4	106.6	.03125
12	CBM COLUMBUS MS	33.39	88.26	104	.03125
13	ABQ KIRTLAND	35.02	106.36	102.9	.03125
14	MCF MACDILL	27.51	82.31	286.6	.03125
15	BIX KEESLER	30.25	88.55	233.3	.03125
16	GFA MALMSTROM	47.3	111.11	402.7	.03125
17	GSB SEYMOUR JOHNSON	35.2	77.58	487.6	.03125
18	GUS GRISSOM	40.39	86.08	0	.03125
19	DLH DULUTH	46.5	92.11	46.9	.03125
20	HMN HOLLOMAN	32.51	106.06	498.4	.03125
21	HST HOMESTEAD	25.29	80.23	452.8	.03125
22	IAB MCCONNELL	37.37	97.16	279.8	.03125
23	DOV DOVER	39.08	75.28	1178.4	.03125
24	LIZ LORING	46.57	67.53	476.6	.03125
25	LRP LITTLE ROCK	34.55	92.08	291.5	.03125
26	DYS DYESS	32.25	99.51	199	.03125
27	FEW FRANCIS E.W.	41.08	104.52	346.7	.03125
28	CHS CHARLESTON	32.54	80.02	959.4	.03125
29	VPS EGLIN	30.29	86.32	754.9	.03125
30	MEM MEMPHIS	35.03	89.58	627.8	.03125
31	MIB MINOT	48.25	101.21	326.4	.03125
32	MTC SELFRIDGE	42.36	82.5	112.3	.03125
33	MUO MOUNTAIN HOME	43.03	115.52	274.6	.03125
34	NIP JACKSONVILLE	30.14	81.4	213.2	.03125
35	NKO NEWARK	40.04	82.24	0	.03125
36	NQX KEY WEST	24.34	81.41	3.1	.03125
37	OFF OFFUTT	41.07	95.55	237.4	.03125
38	OSC WURTSMITH	44.27	83.24	354.9	.03125
39	PAM TYNDALL	30.04	85.35	323	.03125
40	PBG PLATTSBURGH	44.39	73.28	450.2	.03125
41	PSM PEASE	43.04	70.49	493.8	.03125
42	RCA ELLSWORTH	44.09	103.06	663.7	.03125
43	RDR GRAND FORKS	47.57	97.24	315.6	.03125
44	RME GRIFFISS	43.14	75.24	469.3	.03125
45	SAW K.I. SAWYER	46.21	87.23	213.1	.03125
46	SRD NORTON	34.06	117.14	1872	.03125

47	SKA FAIRCHILD	47.37	117.39	290.9	.03125
48	LFI LANGLEY	37.05	76.22	459.3	.03125
49	SSC SHAW	33.58	80.28	503.4	.03125
50	SUU TRAVIS	38.16	121.56	1455.5	.03125
51	SZL WHITEMAN	38.44	93.33	223.3	.03125
52	TCM MCCHORD	47.08	122.28	1052.4	.03125
53	LSV NELLIS	36.14	115.02	372.1	.03125
54	SKP KELLY	29.23	98.35	6936.4	.90625
55	HIF HILL	41.08	111.58	8525.9	.90625
56	MCC MCCLELLAN	38.4	121.24	5146.4	.921875
57	WRB ROBINS	32.38	83.35	5202.6	.921875
58	TIK TINKER	35.25	97.23	5134	.921875

Combined Model (Q & L) Destination Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	DOV DOVER	39.08	75.28	1476.6	.015625
2	LGB LONG BEACH	33.45	118.14	1939.2	.015625
3	WRI MCGUIRE	40.01	74.35	1912	.015625
4	NKT CHERRY POINT	34.54	76.54	1799.9	.015625
5	NPA PENSOCOLA	30.21	87.19	1935.8	.015625
6	NZY SAN DIEGO	32.42	117.12	7313.2	.015625
7	TIK TINKER	35.25	97.23	6261.2	.015625
8	BAD BARKSDALE	32.3	93.4	586.9	.03125
9	CBM COLUMBUS MS	33.39	88.26	163.4	.03125
10	SZL WHITEMAN	38.44	93.33	314.3	.03125
11	DLH DULUTH	46.5	92.11	95.8	.03125
12	DMA DAVIS-MONTHAM	32.1	110.53	469	.03125
13	INH INDIAN HEAD	38.3	77.03	200	.03125
14	DYS DYESS	32.25	99.51	471.6	.03125
15	TWH NAVAL SHIPYARD	36.49	76.18	214.4	.03125
16	DAG DAHLGREN	38.2	77.03	200	.03125
17	BYH IRA EAKER	35.58	89.57	242.4	.03125
18	GFA MALMSTROM	47.3	111.11	552.6	.03125
19	GON NEW LONDON	41.21	72.07	801.9	.03125
20	GSB SEYMOUR JOHNSON	35.2	77.58	653.3	.03125
21	DCA WASHINGTON	38.51	77	661.5	.03125
22	VAD MOODY	30.58	83.12	295.2	.03125
23	HMN HOLLOMAN	32.51	106.06	624.3	.03125
24	HST HOMESTEAD	25.29	80.23	469.4	.03125
25	IAB MCCONNELL	37.37	97.16	399.7	.03125
26	IND WEIR COOK AP	39.43	86.16	754.7	.03125
27	OFF OFFUTT	41.07	95.55	419.6	.03125
28	KBY KINGS BAY	30.48	81.4	257	.03125
29	LFI LANGLEY	37.05	76.22	665.2	.03125
30	PNE PHILADELPHIA-2	39.57	75.07	48.6	.03125
31	ABQ KIRTLAND	35.02	106.36	169.2	.03125
32	MTC SELFRIDGE	42.36	82.5	163.6	.03125
33	LUF LUKE	33.32	112.23	749	.03125
34	COP PATRICK	28.14	80.36	387.82	.03125
35	SSC SHAW	33.58	80.28	630.5	.03125
36	FWH CARSWELL	32.46	97.26	662.3	.03125
37	MEM MEMPHIS	35.03	89.58	109.4	.03125
38	MIB MINOT	48.25	101.21	535.5	.03125
39	BIX KEESLER	30.25	88.55	264.9	.03125
40	MUO MOUNTAIN HOME	43.03	115.52	362.2	.03125
41	NCO NEWPORT	41.28	71.2	276.4	.03125
42	NFL FALLON	39.28	118.47	242.6	.03125
43	GUS GRISSOM	40.39	86.08	16.4	.03125
44	NGZ OAKLAND	37.47	122.13	770.7	.03125
45	NHK PATUXENT RIVER	38.17	76.25	848.4	.03125
46	HIF HILL	41.08	111.58	4910.5	.03125

47	NKO NEWARK	40.04	82.24	23.2	.03125
48	LRF LITTLE ROCK	34.55	92.08	622.8	.03125
49	NLC LEMOORE	36.15	119.57	594.1	.03125
50	PWT BREMERTON	47.34	122.38	1005.6	.03125
51	NQX KEY WEST	24.34	81.41	322	.03125
52	NTD POINT MUGU	34.07	119.07	655.6	.03125
53	NUW WHIDBEY ISLAND	48.17	122.37	730.1	.03125
54	NZJ EL TORO	33.36	117.4	100	.03125
55	LIZ LORING	46.57	67.53	366.3	.03125
56	FEW FRANCIS E.W.	41.08	104.52	442.3	.03125
57	OSC WURTSMITH	44.27	83.24	332.4	.03125
58	PAM TYNDALL	30.04	85.35	353.9	.03125
59	PBG PLATTSBURGH	44.39	73.28	567.3	.03125
60	PHL PHILADELPHIA-1	39.57	75.07	650	.03125
61	AEX ENGLAND	31.2	92.33	144.8	.03125
62	PSM PEASE	43.04	70.49	652.2	.03125
63	VPS EGLIN	30.29	86.32	946.9	.03125
64	RCA ELLSWORTH	44.09	103.06	679	.03125
65	RDR GRAND FORKS	47.57	97.24	442.3	.03125
66	RME GRIFFISS	43.14	75.24	514.6	.03125
67	SAW K.I. SAWYER	46.21	87.23	275.1	.03125
68	LSV NELLIS	36.14	115.02	537.6	.03125
69	SKA FAIRCHILD	47.37	117.39	336.6	.03125
70	SKF KELLY	29.23	98.35	5832.5	.03125
71	MCF MACDILL	27.51	82.31	318	.03125
72	CVS CANNON	34.23	103.19	277.5	.03125
73	CHS CHARLESTON	32.54	80.02	4328.7	.90625
74	NIP JACKSONVILLE	30.14	81.4	4056	.90625
75	NGU NORFOLK	36.57	76.18	9741.401	.90625
76	WRB ROBINS	32.38	83.35	4135.6	.90625
77	SUU TRAVIS AFB	38.16	121.56	9152.3	.90625
78	MCC MCCLELLAN	38.4	121.24	4181.4	.90625
79	TCM MCCHORD AFB	47.08	122.28	2664.9	.921875
80	SBD NORTON	34.06	117.14	2953.1	.921875
81	PFO WRIGHT-PATT	39.49	84.03	2713.2	.921875

Combined Model (Q & L) Origin Cargo Tonnages

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

RANK	NAME	LONG	LAT	TONNAGES	THETA
1	TCM MCCORD AFB	47.08	122.28	2221.4	.015625
2	SKF KELLY	29.23	98.35	6936.4	.015625
3	SUU TRAVIS AFB	38.16	121.56	6943.5	.015625
4	NKT CHERRY POINT	34.54	76.54	2265.4	.015625
5	NPA PENSOCOLA	30.21	87.19	1756.6	.015625
6	PWT BREMERTON	47.34	122.38	1823.6	.015625
7	WRI MCGUIRE	40.01	74.35	1438.8	.015625
8	BAD BARKSDALE	32.3	93.4	106.6	.03125
9	CBM COLUMBUS MS	33.39	88.26	104	.03125
10	SZL WHITEMAN	38.44	93.33	223.3	.03125
11	DLH DULUTH	46.5	92.11	46.9	.03125
12	DMA DAVIS-MONTHAM	32.1	110.53	574.8	.03125
13	DOV DOVER	39.08	75.28	1178.4	.03125
14	DYS DYESS	32.25	99.51	199	.03125
15	TWH NAVAL SHIPYARD	36.49	76.18	377.7	.03125
16	MTC SELFRIDGE	42.36	82.5	112.3	.03125
17	MEM MEMPHIS	35.03	89.58	627.8	.03125
18	ABQ KIRTLAND	35.02	106.36	102.9	.03125
19	DAG DAHLGREN	38.2	77.03	200	.03125
20	GSB SEYMOUR JOHNSON	35.2	77.58	487.6	.03125
21	GUS GRISSOM	40.39	86.08	0	.03125
22	BYH IRA EAKER	35.58	89.57	298.1	.03125
23	HMN HOLLOMAN	32.51	106.06	498.4	.03125
24	HST HOMESTEAD	25.29	80.23	452.8	.03125
25	IAB MCCONNELL	37.37	97.16	279.8	.03125
26	IND WEIR COOK AP	39.43	86.16	597.7	.03125
27	INH INDIAN HEAD	38.3	77.03	200	.03125
28	KBY KINGS BAY	30.48	81.4	0	.03125
29	LFI LANGLEY	37.05	76.22	459.3	.03125
30	LGB LONG BEACH	33.45	118.14	894.3	.03125
31	CVS CANNON	34.23	103.19	223.9	.03125
32	VPS EGLIN	30.29	86.32	754.9	.03125
33	LUF LUKE	33.32	112.23	242.4	.03125
34	COF PATRICK	28.14	80.36	279.1	.03125
35	FWH CARSWELL	32.46	97.26	474.1	.03125
36	MCF MACDILL	27.51	82.31	286.6	.03125
37	GFA MALMSTROM	47.3	111.11	402.7	.03125
38	MJB MINOT	48.25	101.21	326.4	.03125
39	GON NEW LONDON	41.21	72.07	829.2	.03125
40	MUO MOUNTAIN HOME	43.03	115.52	274.6	.03125
41	NCO NEWPORT	41.28	71.2	130.2	.03125
42	NFL FALLON	39.28	118.47	210.9	.03125
43	BIX KEESLER	30.25	88.55	233.3	.03125
44	NGZ OAKLAND	37.47	122.13	681.7	.03125
45	NHK PATUXENT RIVER	38.17	76.25	875	.03125
46	DCA WASHINGTON	38.51	77	985.4	.03125

47	NKO NEWARK	40.04	82.24	0	.03125
48	RDR GRAND FORKS	47.57	97.24	315.6	.03125
49	NLC LEMOORE	36.15	119.57	913.5	.03125
50	LRP LITTLE ROCK	34.55	92.08	291.5	.03125
51	NQX KEY WEST	24.34	81.41	288	.03125
52	NTD POINT MUGU	34.07	119.07	1127.8	.03125
53	NUW WHIDBEY ISLAND	48.17	122.37	841.5	.03125
54	NZJ EL TORO	33.36	117.4	100	.03125
55	NZY SAN DIEGO	32.42	117.12	6584.4	.03125
56	OFF OFFUTT	41.07	95.55	237.4	.03125
57	OSC WURTSMITH	44.27	83.24	354.9	.03125
58	PAM TYNDALL	30.04	85.35	323	.03125
59	PBG PLATTSBURGH	44.39	73.28	450.2	.03125
60	PHL PHILADELPHIA-1	39.57	75.07	504.6	.03125
61	PNE PHILADELPHIA-2	39.57	75.07	327.7	.03125
62	PSM PEASE	43.04	70.49	493.8	.03125
63	RCA ELLSWORTH	44.09	103.06	663.7	.03125
64	LIZ LORING	46.57	67.53	476.6	.03125
65	FEW FRANCIS E.W.	41.08	104.52	346.7	.03125
66	RME GRIFFISS	43.14	75.24	469.3	.03125
67	SAW K.I. SAWYER	46.21	87.23	213.1	.03125
68	LSV NELLIS	36.14	115.02	372.1	.03125
69	SKA FAIRCHILD	47.37	117.39	290.9	.03125
70	AEX ENGLAND	31.2	92.33	81.5	.03125
71	SSC SHAW	33.58	80.28	503.4	.03125
72	VAD MOODY	30.58	83.12	240.1	.03125
73	CHS CHARLESTON	32.54	80.02	4519.7	.90625
74	NGU NORFOLK	36.57	76.18	10999.8	.90625
75	WRB ROBINS	32.38	83.35	5202.6	.90625
76	TIK TINKER	35.25	97.23	5134	.90625
77	MCC MCCLELLAN	38.4	121.24	5146.4	.90625
78	NIP JACKSONVILLE	30.14	81.4	3963.3	.921875
79	HIF HILL	41.08	111.58	8525.901	.921875
80	SBD NORTON	34.06	117.14	3311.6	.921875
81	FFO WRIGHT-PATT	39.49	84.03	3733.8	.921875

Appendix G: Inter-locational mileage

QUICKTRANS Inter-locational air statute mileage

LOC	CHS	COF	DAG	DCA	GON	IND	INH	KBY	LGB	NCO	NFL	NGU	NGZ	NHK	NIP	NKT	NLC
CHS	0	304	426	446	742	586	432	163	2195	775	2182	354	2385	443	184	243	2252
COF	304	0	720	741	1016	847	727	173	2257	1044	2299	630	2485	731	152	496	2340
DAG	426	720	0	21	335	498	7	588	2304	375	2212	122	2433	42	609	254	2322
DCA	446	741	21	0	321	495	15	608	2304	362	2208	141	2430	47	629	275	2320
GON	742	1016	335	321	0	750	331	905	2553	45	2418	389	2647	305	924	520	2550
IND	586	847	498	495	750	0	496	673	1812	796	1715	577	1936	540	695	628	1825
INH	432	727	7	15	331	496	0	594	2304	371	2210	128	2432	43	616	261	2321
KBY	163	173	588	608	905	673	594	0	2149	937	2168	516	2361	606	23	398	2221
LGB	2195	2257	2304	2304	2553	1812	2304	2149	0	2598	403	2362	357	2347	2156	2364	203
NCO	775	1044	375	362	45	796	371	937	2598	0	2461	421	2690	343	956	548	2594
NFL	2182	2299	2212	2208	2418	1715	2210	2168	403	2461	0	2288	234	2253	2178	2316	224
NGU	354	630	122	141	389	577	128	516	2362	421	2288	0	2507	110	536	142	2390
NGZ	2385	2485	2433	2430	2647	1936	2432	2361	357	2690	234	2507	0	2475	2370	2528	168
NHK	443	731	42	47	305	540	43	606	2347	343	2253	110	2475	0	627	251	2365
NIP	184	152	609	629	924	695	616	23	2156	956	2178	536	2370	627	0	415	2229
NKT	243	496	254	275	520	628	261	398	2364	548	2316	142	2528	251	415	0	2404
NLC	2252	2340	2322	2320	2550	1825	2321	2221	203	2594	224	2390	168	2365	2229	2404	0
NPA	452	435	799	814	1134	639	804	345	1821	1174	1869	770	2052	830	345	688	1905
NOX	571	270	990	1011	1282	1077	997	424	2293	1308	2383	899	2552	1001	400	762	2398
NTD	2241	2309	2340	2339	2583	1846	2339	2199	68	2627	361	2401	290	2382	2206	2406	146
NTW	2435	2620	2345	2335	2468	1881	2341	2464	1039	2505	643	2445	738	2382	2480	2509	841
NZJ	2153	2214	2266	2267	2517	1775	2266	2107	43	2562	413	1324	389	2309	2113	2324	228
NZY	2148	2199	2274	2275	2532	1786	2274	2097	92	2577	479	2328	449	2317	2103	2324	293
PHL	559	844	141	127	194	590	137	722	2402	235	2290	216	2516	116	742	356	2411
PNE	559	844	141	127	194	590	137	722	2402	235	2290	216	2516	116	742	356	2411
PWT	2426	2604	2346	2337	2477	1877	2343	2451	984	2515	590	2445	681	2384	2466	2505	785
SBD	2133	2201	2238	2237	2485	1745	2237	2091	70	2529	367	2297	364	2280	2098	2300	198
STU	2350	2457	2391	2388	2601	1894	2390	2330	377	2644	183	2466	57	2433	2340	2490	177
TOM	2418	2595	2342	2333	2475	1872	2338	2442	965	2513	571	2440	663	2380	2457	2500	767
TWH	350	625	127	146	393	579	133	512	2363	425	2290	6	2508	116	531	136	2391
WRI	604	887	190	175	146	627	185	767	2438	187	2320	257	2546	162	788	346	2444

LOC	NPA	NQX	NTD	NUW	NZJ	NZY	PHL	PNE	PWT	SBD	SUU	TCM	TWH	WRI
CHS	452	571	2241	2435	2153	2148	559	559	2426	2133	2350	2418	350	604
COF	435	270	2309	2620	2214	2199	844	844	2604	2201	2457	2595	625	887
DAG	799	990	2340	2345	2266	2274	141	141	2346	2238	2391	2342	127	190
DCA	814	1011	2339	2335	2267	2275	127	127	2337	2237	2388	2333	146	175
GON	1134	1282	2583	2468	2517	2532	194	194	2477	2485	2601	2475	393	146
IND	639	1077	1846	1881	1775	1786	590	590	1877	1745	1894	1872	579	627
INH	804	997	2339	2341	2266	2274	137	137	2343	2237	2390	2338	133	185
KBY	345	424	2199	2464	2107	2097	722	722	2451	2091	2330	2442	512	767
LGB	1821	2293	68	1039	43	92	2402	2402	984	70	377	965	2363	2438
NCO	1174	1308	2627	2505	2562	2577	235	235	2515	2529	2644	2513	425	187
NFL	1869	2383	361	643	413	479	2290	2290	590	367	183	571	2290	2320
NGU	770	899	2401	2445	2324	2328	216	216	2445	2297	2466	2440	6	257
NGZ	2052	2552	290	738	389	449	2516	2516	681	364	57	663	2508	2546
NHK	930	1001	2382	2382	2309	2317	116	116	2384	2280	2433	2380	116	162
NIP	345	400	2206	2480	2113	2103	742	742	2466	2098	2340	2457	531	788
NKT	688	762	2406	2509	2324	2324	356	356	2505	2300	2490	2500	136	396
NLC	1905	2398	146	841	228	293	2411	2411	785	198	177	767	2391	2444
NPA	0	538	1874	2223	1779	1765	940	940	2204	1765	2024	2193	768	989
NQX	538	0	2351	2760	2250	2227	1114	1114	2740	2243	2529	2729	894	1156
NTD	1874	2351	0	988	108	160	2435	2435	932	109	314	913	2402	2470
NUW	2223	2760	988	0	1054	1121	2386	2386	57	1010	692	75	2448	2404
NZJ	1779	2250	108	1054	0	67	2365	2365	999	50	405	980	2324	2401
NZY	1765	2227	160	1121	67	0	2376	2376	1066	113	468	1047	2329	2413
PHL	940	1114	2435	2386	2365	2376	0	0	2391	2335	2471	2388	221	48
PNE	940	1114	2435	2386	2365	2376	0	0	2391	2335	2471	2388	221	48
PWT	2204	2740	932	57	999	1066	2391	2391	0	955	635	19	2448	2409
SBD	1765	2243	109	1010	50	113	2335	2335	955	0	374	937	2298	2370
SUU	2024	2529	314	692	405	468	2471	2471	635	374	0	617	2468	2501
TCM	2193	2729	913	75	980	1047	2388	2388	19	937	617	0	2443	2407
TWH	768	894	2402	2448	2324	2329	221	221	2448	2298	2468	2443	0	262
WRI	989	1156	2470	2404	2401	2413	48	48	2409	2370	2501	2407	262	0

QUICKTRANS Inter-locational surface statute mileage

LOC	CHS	COP	DAG	DCA	GON	IND	INH	KBY	LGB	NCO	NFL	NGU	NGZ	NHK	NIP	NKT	NLC
CHS	0	364	511	535	890	704	519	196	2634	929	2618	425	2861	532	221	292	2702
COP	364	0	864	889	1219	1016	872	208	2708	1252	2759	757	2982	878	182	595	2808
DAG	511	864	0	26	402	597	8	705	2765	450	2654	146	2920	51	731	305	2787
DCA	535	889	26	0	385	594	17	729	2765	434	2649	169	2916	56	755	330	2785
GON	890	1219	402	385	0	901	397	1085	3064	54	2902	467	3176	366	1109	625	3060
IND	704	1016	597	594	901	0	596	808	2175	955	2057	692	2323	648	834	754	2190
INH	519	872	8	17	397	596	0	713	2764	445	2652	154	2918	52	739	313	2786
KBY	196	208	705	729	1085	808	713	0	2579	1124	2601	620	2833	727	28	478	2665
LGB	2634	2708	2765	2765	3064	2175	2764	2579	0	3117	483	2835	428	2816	2587	2837	244
NCO	929	1252	450	434	54	955	445	1124	3117	0	2953	505	3228	412	1148	658	3113
NFL	2618	2759	2654	2649	2902	2057	2652	2601	483	2953	0	2746	281	2704	2614	2779	269
NGU	425	757	146	169	467	692	154	620	2835	505	2746	0	3008	133	643	170	2868
NGZ	2861	2982	2920	2916	3176	2323	2918	2833	428	3228	281	3008	0	2970	2844	3034	202
NHK	532	878	51	56	366	648	52	727	2816	412	2704	133	2970	0	752	301	2837
NIP	221	182	731	755	1109	834	739	28	2587	1148	2614	643	2844	752	0	498	2675
NKT	292	595	305	330	625	754	313	478	2837	658	2779	170	3034	301	498	0	2885
NLC	2702	2808	2787	2785	3060	2190	2786	2665	244	3113	269	2868	202	2837	2675	2885	0
NPA	542	523	959	977	1361	767	964	414	2186	1408	2243	925	2462	997	414	826	2286
NQX	686	324	1188	1214	1538	1293	1196	508	2752	1570	2860	1079	3062	1201	480	914	2878
NTD	2689	2771	2808	2807	3099	2215	2807	2639	82	3153	433	2881	349	2859	2647	2887	176
NUW	2922	3143	2814	2802	2962	2258	2810	2957	1247	3006	772	2934	886	2858	2976	3011	1010
NZJ	2584	2657	2720	2720	3021	2130	2719	2529	52	3075	495	2788	466	2770	2536	2789	274
NZY	2578	2639	2729	2730	3038	2144	2729	2517	111	3092	575	2794	539	2780	2523	2789	351
PHL	670	1013	170	152	233	708	164	866	2883	282	2748	259	3019	139	891	428	2893
PNE	670	1013	170	152	233	708	164	866	2883	282	2748	259	3019	139	891	428	2893
PWT	2911	3125	2815	2804	2972	2253	2811	2941	1180	3018	707	2933	817	2860	2959	3006	942
SBQ	2560	2641	2685	2685	2982	2094	2684	2509	84	3035	441	2756	437	2736	2517	2760	237
SUU	2820	2948	2869	2865	3121	2272	2867	2796	452	3173	220	2959	68	2919	2808	2988	212
TCM	2902	3114	2810	2799	2970	2246	2806	2931	1158	3016	685	2928	796	2855	2949	3000	920
TWH	420	750	152	176	472	695	160	614	2836	510	2748	7	3010	139	638	163	2870
WRI	725	1065	228	210	175	752	222	921	2926	225	2784	308	3055	195	945	475	2932

LOC	NPA	NQX	NTD	NUW	NZJ	NZY	PHL	PNE	PWT	SED	SUU	TCM	TWH	WRI
CHS	542	686	2689	2922	2584	2578	670	670	2911	2560	2820	2902	420	725
COF	523	324	2771	3143	2657	2639	1013	1013	3125	2641	2948	3114	750	1065
DAG	959	1188	2808	2814	2720	2729	170	170	2815	2685	2869	2810	152	228
DCA	977	1214	2807	2802	2720	2730	152	152	2804	2685	2865	2799	176	210
GON	1361	1538	3099	2962	3021	3038	233	233	2972	2982	3121	2970	472	175
IND	767	1293	2215	2258	2130	2144	708	708	2253	2094	2272	2246	695	752
INH	964	1196	2807	2810	2719	2729	164	164	2811	2684	2867	2806	160	222
KBY	414	508	2639	2957	2529	2517	866	866	2941	2509	2796	2931	614	921
LGB	2186	2752	82	1247	52	111	2883	2883	1180	84	452	1158	2836	2926
NCO	1408	1570	3153	3006	3075	3092	282	282	3018	3035	3173	3016	510	225
NFL	2243	2860	433	772	495	575	2748	2748	707	441	220	685	2748	2784
NGU	925	1079	2881	2934	2788	2794	259	259	2933	2756	2959	2928	7	308
NGZ	2462	3062	349	886	466	539	3019	3019	817	437	68	796	3010	3055
NHK	997	1201	2859	2858	2770	2780	139	139	2860	2736	2919	2855	139	195
NIP	414	480	2647	2976	2536	2523	891	891	2959	2517	2808	2949	638	945
NKT	826	914	2887	3011	2789	2789	428	428	3006	2760	2988	3000	163	475
NLC	2286	2878	176	1010	274	351	2893	2893	942	237	212	920	2870	2932
NPA	0	646	2249	2668	2135	2118	1129	1129	2645	2118	2429	2632	921	1187
NQX	646	0	2821	3312	2700	2673	1336	1336	3288	2691	3035	3275	1073	1387
NTD	2249	2821	0	1185	129	192	2922	2922	1118	130	377	1096	2882	2964
NUW	2668	3312	1185	0	1265	1345	2864	2864	69	1212	830	90	2938	2884
NZJ	2135	2700	129	1265	0	80	2839	2839	1199	60	486	1177	2789	2882
NZY	2118	2673	192	1345	80	0	2852	2852	1279	136	562	1257	2794	2896
PHL	1129	1336	2922	2864	2839	2852	0	0	2869	2802	2966	2865	265	58
PNE	1129	1336	2922	2864	2839	2852	0	0	2869	2802	2966	2865	265	58
PWT	2645	3298	1118	69	1199	1279	2869	2869	0	1147	762	22	2937	2891
SRD	2118	2691	130	1212	60	136	2802	2802	1147	0	449	1124	2757	2844
SUU	2429	3035	377	830	486	562	2966	2966	762	449	0	740	2961	3002
TCM	2632	3275	1096	90	1177	1257	2865	2865	22	1124	740	0	2931	2888
TWH	921	1073	2882	2938	2789	2794	265	265	2937	2757	2961	2931	0	315
WRI	1187	1387	2964	2884	2882	2896	58	58	2891	2844	3002	2888	315	0

LOGAIR Inter-locational air statute mileage

	ABQ	AEX	BAD	BIX	BYH	CRM	CHS	COF	CVS	DLH	DMA	DOV	DYS	PEW	PFO	PWH	GPA
ABQ	0	852	767	1084	945	1037	1516	1595	188	1084	313	1726	437	430	1261	551	882
AEX	852	0	98	234	341	281	727	748	664	1056	1070	1102	427	960	738	302	1489
BAD	767	98	0	319	315	307	779	828	580	982	999	1115	356	862	721	225	1391
BIX	1084	234	319	0	372	217	526	514	896	1137	1302	967	661	1163	687	535	1678
BYH	945	341	315	372	0	168	584	744	776	765	1223	819	613	892	406	489	1369
CRM	1037	281	307	217	168	0	481	592	857	927	1292	822	656	1036	482	524	1528
CHS	1516	727	779	526	584	481	0	304	1337	1155	1773	523	1134	1470	529	1002	1916
COF	1595	748	828	514	744	592	304	0	1408	1418	1815	809	1175	1628	811	1049	2113
CVS	188	664	580	896	776	857	1337	1408	0	1025	449	1574	252	478	1116	363	991
DLH	1084	1056	982	1137	765	927	1155	1418	1025	0	1391	991	1058	721	632	1006	895
DMA	313	1070	999	1302	1223	1292	1773	1815	449	1391	0	2022	643	703	1561	774	1049
DOV	1726	1102	1115	967	819	822	523	809	1574	991	2022	0	1432	1543	468	1308	1871
DYS	437	427	356	661	613	656	1134	1175	252	1058	643	1432	0	669	997	132	1204
PEW	430	960	862	1163	892	1036	1470	1628	478	721	703	1543	669	0	1082	717	539
PFO	1261	738	721	687	406	482	529	811	1116	632	1561	468	997	1082	0	882	1452
PWH	551	302	225	535	489	524	1002	1049	363	1006	774	1308	132	717	882	0	1255
GPA	882	1489	1391	1678	1369	1528	1916	2113	991	895	1049	1871	1204	539	1452	1255	0
GBR	1619	894	928	722	675	622	231	514	1450	1084	1896	296	1272	1510	461	1142	1910
GUS	1164	723	690	713	382	498	637	906	1028	518	1469	580	932	963	125	826	1326
HIF	505	1267	1171	1485	1246	1381	1829	1970	658	1036	622	1908	903	267	1448	988	430
HMN	174	809	737	1042	965	1031	1511	1556	204	1214	262	1772	382	597	1316	512	1054
HST	1691	840	931	612	901	739	500	197	1503	1603	1886	994	1259	1765	1004	1140	2266
IAB	537	507	409	696	439	570	1023	1162	401	681	840	1189	377	469	724	339	985
LFI	1681	1003	1027	848	748	724	378	660	1520	1042	1968	149	1359	1534	455	1231	1900
LIZ	2153	1690	1681	1590	1367	1417	1171	1449	2036	1162	2465	648	1951	1862	962	1841	2027
LRF	809	232	173	361	159	233	707	820	632	825	1075	978	456	812	559	331	1319
LSV	492	1343	1259	1576	1420	1523	1999	2087	680	1378	379	2164	924	660	1697	1042	796
LUF	355	1169	1093	1402	1296	1378	1859	1916	522	1393	130	2081	741	682	1616	869	966
MCC	854	1704	1615	1934	1748	1865	2332	2440	1042	1574	743	2447	1291	905	1984	1404	798
MCF	1505	654	741	422	701	539	373	127	1318	1415	1714	895	1078	1567	832	955	2066
MEM	946	308	289	335	38	136	575	721	774	802	1218	835	601	911	433	474	1394
MIB	950	1265	1173	1410	1056	1224	1544	1778	973	442	1216	1431	1108	521	1043	1109	463
MTC	1375	941	915	900	602	694	691	988	1248	552	1685	440	1162	1134	213	1056	1432
MUD	738	1507	1410	1723	1471	1611	2048	2202	898	1167	802	2091	1145	579	1642	1230	364
NIP	1486	653	723	426	604	461	184	152	1301	1266	1721	708	1077	1494	662	948	1970
NKO	1360	831	818	763	504	567	532	823	1217	666	1662	376	1099	1167	102	984	1510
NOX	1661	817	911	598	915	749	572	270	1473	1640	1843	1078	1225	1760	1056	1111	2270
OFF	720	704	617	843	498	663	1038	1237	630	412	1033	1077	647	466	616	602	879
OGC	1378	1028	991	1010	686	798	828	1124	1266	456	1690	544	1206	1098	332	1110	1350
PAM	1267	422	500	191	454	388	358	328	1080	1192	1492	845	849	1314	656	722	1810
PBG	1856	1375	1365	1282	1051	1103	894	1187	1731	921	2166	381	1638	1590	646	1527	1311
PCM	1984	1446	1447	1328	1128	1168	890	1166	1851	1082	2291	370	1740	1737	743	1623	1975
PCA	650	1063	966	1240	923	1083	1472	1667	680	556	920	1467	839	221	1026	861	446
RDR	985	1159	1073	1281	916	1084	1373	1618	971	252	1275	1242	1064	574	863	1043	647
RME	1747	1245	1237	1152	923	973	776	1074	1617	856	2055	280	1515	1498	520	1402	1751
SAW	1259	1071	1014	1104	743	886	1018	1302	1175	233	1572	779	1163	931	491	1087	1127
SRD	616	1452	1373	1685	1560	1652	2132	2199	796	1562	405	2325	1025	842	1857	1150	966
SFA	1024	1729	1630	1930	1639	1793	2197	2383	1168	1187	1114	2164	1403	769	1742	1473	294
SFF	615	394	362	591	673	659	1108	1090	447	1238	749	1476	219	888	1078	232	1421
SFO	1486	721	764	536	545	460	72	375	1310	1086	1750	470	1116	1621	458	984	1874
SHE	848	1719	1631	1950	1766	1882	2350	2457	1056	1597	749	2468	1307	926	2005	1419	821
TEL	757	503	424	627	286	449	850	1020	620	560	1061	971	551	620	504	468	1030
TCM	1170	1923	1825	2131	1854	2003	2418	2595	1329	1417	1295	2394	1574	970	1979	1654	524
TIE	510	397	299	610	431	526	1002	1103	345	820	793	1232	245	564	780	193	1094
VAD	1379	547	616	324	508	358	227	236	1194	1199	1614	735	971	1394	617	441	1877
VPS	1207	362	440	133	411	243	402	388	1020	1161	1431	871	789	1259	648	661	1762
WBR	1330	533	586	340	419	293	194	343	1149	1079	1582	646	941	1311	492	810	1780
WPI	1775	1174	1184	1044	883	894	604	888	1628	995	2075	81	1495	1576	515	1372	1884

	GSB	GUS	HIF	HMN	HST	IAB	LFI	LIZ	LRP	LSV	LUF	MCC	MCP	MEM	MIB	MTC	MUO
ABQ	1619	1164	505	174	1691	537	1681	2153	809	492	355	854	1505	946	950	1375	738
AEX	894	723	1267	809	840	507	1003	1690	232	1343	1169	1704	654	308	1265	941	1507
BAD	928	690	1171	737	931	409	1027	1681	173	1259	1093	1615	741	289	1173	915	1410
BIX	722	713	1485	1042	612	696	848	1590	361	1576	1402	1934	422	335	1410	900	1723
BYH	675	382	1246	965	901	439	748	1367	159	1420	1296	1748	701	38	1056	602	1471
CBM	622	498	1381	1031	739	570	724	1417	233	1523	1378	1865	539	136	1224	694	1611
CHS	231	637	1829	1511	500	1023	378	1171	707	1999	1859	2332	373	575	1544	691	2048
COF	514	906	1970	1556	197	1162	660	1449	820	2087	1916	2440	127	721	1778	988	2202
CVS	1450	1028	658	204	1503	401	1520	2036	632	680	522	1042	1318	774	973	1248	898
DLH	1084	518	1036	1214	1603	681	1042	1162	825	1378	1393	1574	1415	802	442	552	1167
DMA	1896	1469	622	262	1886	840	1968	2465	1075	379	130	743	1714	1218	1216	1685	802
DOV	296	580	1908	1772	994	1189	149	648	978	2164	2081	2447	895	835	1431	440	2091
DYS	1272	932	903	382	1259	377	1359	1951	456	924	741	1291	1078	601	1108	1162	1145
FEW	1510	963	367	597	1765	469	1534	1862	812	660	682	905	1567	911	521	1134	579
FFO	461	125	1448	1316	1004	724	455	962	559	1697	1616	1984	832	433	1043	213	1642
FWH	1142	826	988	512	1140	339	1231	1841	331	1042	869	1404	955	474	1109	1056	1230
GFA	1910	1326	430	1054	2266	985	1900	2027	1319	796	966	798	2066	1394	463	1432	364
GSB	0	586	1877	1637	702	1097	148	942	822	2087	1970	2400	599	678	1504	560	2083
GUS	586	0	1329	1231	1095	630	579	1019	520	1587	1517	1867	914	416	920	230	1519
HIF	1877	1329	0	665	2096	811	1901	2196	1151	388	537	545	1900	1261	709	1493	243
HMN	1637	1231	665	0	1633	604	1713	2239	815	568	362	943	1457	959	1115	1452	889
HST	702	1095	2096	1633	0	1296	845	1626	953	2181	1995	2544	200	873	1949	1185	2332
IAB	1097	630	811	604	1296	0	1149	1635	343	990	892	1310	1098	451	778	848	1041
LFI	148	579	1901	1713	845	1149	0	793	904	2135	2035	2434	748	758	1475	495	2097
LIZ	942	1019	2196	2239	1626	1635	793	0	1522	2521	2496	2736	1541	1393	1564	791	2326
LRP	822	520	1151	815	953	343	904	1522	0	1292	1154	1632	754	145	1055	747	1383
LSV	2087	1587	388	568	2181	990	2135	2521	1292	0	251	375	1997	1425	1090	1778	476
LUF	1970	1517	537	362	1995	892	2035	2496	1154	251	0	613	1818	1295	1177	1725	693
MCC	2400	1867	545	943	2544	1310	2434	2736	1632	375	613	0	2356	1757	1208	2037	437
MCP	599	914	1900	1457	200	1098	748	1541	754	1997	1818	2356	0	673	1752	1025	2131
MEM	678	416	1261	959	873	451	758	1393	145	1425	1295	1757	673	0	1089	633	1468
MIB	1504	920	709	1115	1949	778	1475	1564	1055	1090	1177	1208	1752	1089	0	991	777
MTC	560	230	1493	1452	1185	848	495	791	747	1778	1725	2037	1025	633	991	0	1664
MUO	2083	1519	243	889	2332	1041	2097	2326	1383	476	693	437	2135	1488	777	1664	0
NIP	414	755	1841	1449	342	1031	562	1355	693	1976	1816	2323	190	583	1628	845	2070
NKO	420	204	1532	1418	1024	823	385	863	660	1790	1714	2071	865	530	1092	161	1720
NOX	783	1140	2081	1594	99	1292	929	1715	952	2149	1955	2515	226	885	1971	1245	2320
OFF	1053	497	833	827	1398	269	1070	1437	488	1101	1059	1370	1199	527	568	677	1030
OSC	694	305	1447	1469	1320	867	619	776	819	1753	1720	1991	1158	721	898	137	1603
PAM	575	715	1649	1231	453	845	713	1487	501	1759	1590	2113	254	423	1510	865	1880
PBG	674	708	1927	1935	1374	1331	529	316	1206	2244	2204	2481	1267	1077	1349	483	2086
PCM	660	823	2088	2053	1743	1452	512	283	1296	2386	2335	2633	1259	1160	1514	610	2243
PDA	1478	902	480	815	1821	557	1480	1717	879	835	891	1019	1621	949	300	1038	627
PDR	1322	742	836	1137	1795	704	1288	1389	937	1202	1255	1359	1601	951	189	803	938
PME	562	589	1851	1820	1264	1217	423	445	1079	2147	2097	2396	1148	949	1293	372	2010
SAW	911	406	1261	1373	1494	794	848	935	844	1591	1586	1802	1318	781	669	354	1399
SRD	2232	1751	572	648	2291	1140	2289	2700	1425	187	286	376	2103	1562	1277	1948	623
SEA	2199	1617	520	1185	2529	1235	2192	2307	1576	784	1006	649	2329	1662	751	1726	313
SFF	1278	1935	1104	509	1141	166	1383	2040	519	1077	865	1451	980	649	1021	1264	1147
SFO	190	568	1723	1489	572	922	331	1118	678	1964	1812	2292	436	540	1479	618	1910
SJP	2420	1893	567	954	2554	1124	2457	2759	1649	386	625	24	2371	1775	1232	2159	101
STL	897	409	943	823	1196	221	937	1419	277	1198	1112	1503	986	313	731	629	1140
TOM	2421	1445	572	1417	2735	1419	2420	2531	1782	842	1041	601	2537	1875	979	1956	141
TUL	1106	702	875	510	1221	146	1175	1720	295	997	865	1340	1027	431	920	978	1118
VAC	462	647	1739	1353	405	829	596	1382	589	1869	1709	2217	217	485	1546	814	1969
VFC	610	607	1591	1171	507	789	743	1507	446	1698	1530	2053	309	378	1467	859	1826
WFB	384	573	1663	1320	524	853	517	1297	525	1816	1670	2156	342	402	1436	690	1889
WRI	376	619	1939	1828	1071	1238	228	567	1042	2206	2130	2480	975	901	1437	453	2116

	NIP	NKO	NQX	OFF	OSC	PAM	PBG	PSM	RCA	RDR	RME	SAW	SBD	SKA	SKF	SSC	SUU
ABQ	1486	1360	1661	720	1378	1267	1856	1984	650	985	1747	1259	616	1024	615	1486	868
AEX	653	831	817	704	1028	422	1375	1446	1063	1159	1245	1071	1452	1729	384	721	1719
BAD	723	818	911	617	991	500	1365	1447	966	1073	1237	1014	1373	1630	362	764	1631
BIX	426	763	598	843	1010	191	1282	1328	1240	1281	1152	1104	1685	1930	591	536	1950
BYH	604	504	915	498	686	454	1051	1138	923	916	923	743	1560	1639	673	545	1766
CBM	461	567	749	663	798	288	1103	1168	1083	1084	973	886	1652	1793	659	460	1882
CHS	184	532	572	1038	828	358	894	890	1472	1373	776	1018	2132	2197	1108	73	2350
COF	152	828	270	1237	1124	328	1187	1166	1667	1618	1074	1302	2199	2383	1090	375	2457
CVS	1301	1217	1473	630	1266	1080	1731	1851	680	971	1617	1175	796	1168	447	1310	1056
DLH	1266	666	1640	412	456	1192	921	1082	556	252	856	233	1562	1187	1238	1086	1597
DMA	1721	1662	1843	1033	1690	1492	2166	2291	920	1275	2055	1572	405	1114	749	1750	749
DOV	708	376	1078	1077	544	845	381	370	1467	1242	280	779	2325	2164	1476	470	2468
DYS	1077	1099	1225	647	1206	849	1638	1740	839	1064	1515	1163	1025	1403	219	1116	1305
FEW	1494	1167	1760	466	1098	1314	1590	1737	221	574	1498	931	842	769	888	1421	926
FFO	662	102	1056	616	332	656	646	743	1026	863	520	491	1857	1742	1078	458	2005
FWH	948	984	1111	602	1110	722	1527	1623	861	1043	1402	1087	1150	1473	232	984	1419
GFA	1970	1515	2270	879	1350	1813	1811	1975	446	647	1751	1127	966	294	1421	1858	822
GGB	414	420	783	1053	694	575	674	660	1478	1322	562	911	2232	2199	1278	190	2429
GUS	755	204	1140	497	305	715	708	823	902	742	589	406	1751	1617	1035	568	1888
HIF	1841	1532	2081	833	1447	1649	1937	2088	480	836	1851	1261	572	520	1104	1783	567
HMN	1459	1418	1594	827	1469	1231	1925	2053	815	1137	1820	1373	648	1185	509	1489	954
HST	342	1024	99	1398	1320	453	1374	1343	1821	1795	1264	1494	2281	2529	1143	572	2558
IAB	1031	823	1292	269	867	845	1331	1452	557	704	1217	794	1140	1235	566	982	1328
LFI	562	385	929	1070	619	713	529	512	1480	1288	423	848	2289	2192	1383	331	2455
LIZ	1355	863	1715	1437	776	1487	316	283	1717	1389	445	935	2700	2307	2040	1118	2759
LRF	693	660	952	488	819	501	1206	1296	879	937	1079	844	1425	1576	519	678	1649
LSV	1976	1790	2149	1101	1753	1759	2244	2386	835	1202	2147	1591	187	784	1677	1964	386
LUC	1816	1714	1955	1059	1720	1590	2204	2335	891	1255	2097	1586	286	1006	865	1832	629
MCF	2323	2071	2515	1370	1991	2113	2481	2633	1019	1359	2396	1802	376	649	1551	2292	24
MCF	190	365	226	1199	1158	254	1267	1259	1621	1601	1148	1318	2103	2329	980	336	2371
MEM	583	530	885	527	721	423	1077	1160	949	951	949	781	1562	1662	619	540	1775
MIR	1628	1092	1971	568	898	1510	1319	1514	300	189	1293	669	1277	751	1321	1479	1232
MTG	845	161	1245	677	137	865	483	610	1038	803	372	354	1948	1726	1264	614	2059
MTG	2070	1720	2320	1090	1601	1883	2085	2243	627	938	2010	1399	625	313	1345	1999	461
NIP	0	635	403	1492	989	236	1078	1074	1524	1467	959	1152	2096	2243	1017	246	2340
NKO	685	0	1034	701	296	712	517	641	1099	907	420	494	1952	1809	1177	759	2092
NQX	430	1084	0	1412	1379	462	1457	1432	1828	1822	1344	1543	2241	2127	1845	641	2124
OFF	1992	701	1412	0	662	951	1148	1286	435	456	1047	546	1272	1159	882	962	1392
OSC	989	296	1379	662	0	989	491	641	978	708	406	236	1929	1643	1328	754	2014
PAM	236	712	1662	951	989	0	1189	1214	1369	1364	1062	1120	1872	2876	791	385	2129
PBG	1078	547	1457	1148	491	1189	0	167	1464	1165	120	688	2419	2160	1724	814	2503
PSM	1074	641	1432	1236	641	1214	167	0	1619	1328	239	849	2558	2265	1809	840	2617
RCA	1524	1099	1828	435	978	1369	1464	1619	0	369	1385	783	1021	725	1057	1416	1342
RDR	1467	907	1822	456	708	1364	1165	1323	369	0	1105	481	1389	937	1267	1306	1383
RME	959	420	1144	1047	406	1062	130	239	1385	1105	0	625	2319	2043	1596	719	2418
SAW	1172	494	1543	546	236	1120	688	849	783	481	625	0	1772	1418	1316	945	1825
SBD	2096	1953	2241	1272	1929	1872	2419	2558	1021	1389	2319	1772	0	918	1151	2102	175
SKA	2247	1808	2527	1119	1643	2076	2100	2265	725	937	2043	1418	918	0	1613	2141	609
SKF	1917	1177	1047	412	142	741	1724	1809	1057	1267	1596	1316	1151	1612	0	114	140
SSC	246	474	641	982	774	865	874	840	1416	1306	713	945	2102	2141	1151	0	2114
SUU	2149	2092	2129	1092	2114	2129	2607	2655	1042	1183	2418	1825	377	669	1461	2114	0
TEL	999	602	1147	216	649	716	1112	1231	617	667	997	619	1255	1256	607	641	172
TRF	1477	2616	2729	1401	1872	2281	2728	2499	948	1107	2272	1647	947	249	1776	249	617
VAL	683	892	1247	412	668	777	1410	1521	684	870	1291	918	1131	1331	429	677	1557
VAT	147	641	1443	142	945	118	1093	1105	1440	1366	969	1131	1949	2147	916	265	2294
VFB	294	711	589	905	974	60	1204	1237	1319	1326	1076	1107	1811	2022	724	421	2069
WBB	193	532	587	901	821	269	990	1014	1334	1276	863	976	1945	2055	914	196	2177
WRI	788	417	1156	1111	541	926	207	1490	1490	1248	221	776	2369	2177	1545	551	2512

	SZL	TCM	TIK	VAD	VFS	WRB	WRI
ABQ	757	1170	515	1379	1207	1330	1775
AEX	503	1923	397	547	362	533	1174
BAD	424	1825	299	616	440	586	1184
BIX	627	2131	610	324	133	340	1044
BYH	286	1854	431	508	411	410	883
CEM	449	2003	526	358	243	293	894
CHS	850	2418	1002	227	402	194	604
COF	1030	2595	1103	236	388	343	888
CYS	620	1329	345	1194	1020	1149	1628
DLH	560	1417	820	1199	1161	1079	995
DMA	1061	1205	793	1614	1431	1582	2075
DOV	971	2394	1232	735	871	646	81
DYC	551	1574	245	971	789	941	1495
FEW	620	970	564	1394	1259	1311	1576
FFO	504	1970	780	617	648	492	515
FWH	468	1654	193	841	661	810	1372
GFA	1083	524	1096	1877	1762	1780	1884
GGB	897	2425	1106	452	610	384	376
GUC	409	1845	702	697	697	573	619
HIF	983	672	875	1739	1591	1663	1939
HNN	823	1317	560	1353	1171	1320	1828
HST	1186	2735	1221	405	507	524	1071
IAB	221	1439	146	929	789	853	1238
LFI	937	2420	1175	596	743	517	228
LIZ	1419	2531	1720	1382	1507	1287	567
LRF	277	1782	295	589	446	525	1042
LDV	1198	842	997	1869	1698	1816	2206
LUT	1112	1085	865	1709	1530	1670	2130
MCC	1503	601	1340	2217	2053	2156	2480
MCF	986	2537	1027	217	309	342	975
MEM	313	1875	431	485	378	402	901
MIB	783	979	920	1546	1467	1436	1437
MTC	629	1956	930	814	859	690	453
MUD	1199	432	1113	1969	1826	1889	2116
NIP	888	2457	983	107	294	194	788
NFO	602	2036	882	655	711	532	417
NIN	1197	2729	1207	443	509	567	1156
OFF	216	1381	412	1292	961	961	1111
OGG	659	1872	966	945	979	820	541
PAN	726	2283	777	138	60	200	926
PHG	1112	2328	1410	1093	1204	990	307
POM	1231	2493	1521	1105	1237	1014	289
POA	637	948	684	1420	1314	1224	1490
RDR	660	1167	859	1390	1326	1276	1243
RNE	997	2272	1291	969	1076	863	221
SAW	619	1647	918	1101	1106	976	776
SBD	1355	947	1131	1989	1812	1945	2369
SFA	1376	230	1331	2147	2002	2055	2177
SKE	697	1776	429	915	724	914	1545
SMT	901	2363	974	265	421	196	541
SOL	1501	615	1557	2235	2144	2171	2502
SRL	0	1772	0	74	0	649	1014
TOM	1572	0	1526	2114	2118	2271	2407
TTH	203	1526	0	817	716	819	1299
VAD	741	2359	877	0	101	125	816
VIC	689	2421	719	191	0	227	950
WBB	699	2111	819	121	227	0	726
WRI	1018	2407	1289	816	975	726	0

LOGAIR Inter-locational surface statute mileage

LOC	ABQ	AEX	BAD	BIX	BYH	CBM	CHS	COP	CVS	DLH	DMA	DOV	DYS	FEW	PFO	FWH	GFA
ABQ	0	1022	920	1301	1134	1244	1819	1914	226	1301	376	2071	525	516	1513	661	1058
AEX	1022	0	118	280	410	337	872	897	797	1267	1283	1323	513	1153	885	362	1787
BAD	920	118	0	383	378	368	935	994	696	1179	1199	1338	428	1034	865	270	1669
BIX	1301	280	383	0	447	261	632	617	1076	1365	1562	1160	793	1395	824	642	2014
BYH	1134	410	378	447	0	202	701	893	931	918	1467	983	736	1071	487	587	1643
CBM	1244	337	368	261	202	0	577	711	1028	1112	1551	986	787	1243	578	629	1833
CHS	1819	872	935	632	701	577	0	365	1605	1387	2128	628	1361	1764	635	1203	2299
COP	1914	897	994	617	893	711	365	0	1690	1701	2178	971	1410	1954	973	1258	2536
CVS	226	797	696	1076	931	1028	1605	1690	0	1231	538	1889	303	574	1339	435	1189
DLH	1301	1267	1179	1365	918	1112	1387	1701	1231	0	1670	1189	1270	865	758	1208	1074
DMA	376	1283	1199	1562	1467	1551	2128	2178	538	1670	0	2427	772	844	1874	929	1259
DOV	2071	1323	1338	1160	983	986	628	971	1889	1189	2427	0	1719	1851	562	1570	2243
DYS	525	513	428	792	736	787	1361	1410	303	1270	772	1719	0	803	1197	158	1445
FEW	516	1153	1034	1395	1071	1243	1764	1954	574	865	844	1851	803	0	1298	860	646
FFO	1513	885	865	824	487	578	635	973	1339	758	1874	562	1197	1298	0	1059	1742
FWH	661	362	270	642	587	629	1203	1258	435	1208	929	1570	158	860	1059	0	1506
GFA	1058	1787	1669	2014	1643	1833	2299	2536	1189	1074	1259	2243	1445	646	1742	1506	0
GSB	1943	1073	1114	866	809	746	277	616	1740	1301	2275	355	1527	1813	553	1370	2292
GUE	1397	868	828	856	458	597	765	1087	1234	622	1763	696	1118	1156	151	991	1591
HIF	606	1520	1405	1782	1476	1657	2194	2264	789	1243	747	2289	1083	431	1738	1185	516
HNN	209	971	885	1250	1153	1237	1813	1867	244	1457	315	2126	458	717	1580	614	1265
HET	2029	1008	1117	735	1081	886	600	236	1803	1923	2264	1193	1510	2119	1205	1268	2719
IAB	644	608	491	835	526	684	1228	1394	481	817	1008	1427	453	563	869	407	1182
LFI	2017	1204	1232	1018	898	869	454	792	1824	1251	2362	179	1631	1841	546	1477	2280
LIZ	2584	2028	2018	1908	1641	1700	1405	1739	2443	1394	2958	778	2341	2234	1155	2210	2432
LRF	970	278	207	434	191	279	849	984	759	989	1290	1174	547	975	671	397	1583
LOV	590	1612	1511	1891	1704	1828	2398	2504	815	1654	454	2597	1109	792	2036	1250	955
LUF	426	1402	1311	1682	1555	1653	2230	2299	627	1672	156	2497	889	819	1939	1042	1160
MCC	1025	2044	1939	2321	2097	2238	2798	2928	1250	1889	891	2936	1549	1086	2381	1685	319
MCF	1807	785	889	506	841	646	448	152	1581	1697	2057	1074	1294	1880	999	1147	2479
MEM	1136	370	346	402	46	163	690	865	928	963	1462	1002	721	1093	520	569	1677
MIB	1140	1518	1408	1692	1268	1469	1853	2133	1167	530	1459	1717	1329	625	1251	1350	516
MTC	1651	1129	1098	1080	722	932	829	1186	1498	663	2024	528	1394	1061	256	1267	1719
MUO	886	1808	1692	2067	1765	1933	2458	2643	1078	1400	962	2509	1374	695	1970	1476	1437
NIP	1783	783	868	512	725	553	221	182	1561	1520	2065	849	1293	1792	794	1197	2764
NKO	1642	997	982	916	687	680	638	994	1660	799	1994	451	1319	1400	123	1141	1811
NPA	1993	980	1093	718	1094	499	646	324	1768	1967	2212	1294	1470	2112	1268	1354	2704
OLF	864	845	740	1011	598	796	1246	1385	755	494	1239	1292	776	560	739	722	1411
ORC	1651	1233	1189	1212	924	957	993	1349	1519	543	2028	653	1647	1318	399	1332	1842
PAN	1129	536	630	240	547	445	430	394	1296	1431	1720	1014	1019	1576	788	866	2175
PBI	2227	1650	1639	1538	1261	1324	1873	1425	2078	1105	2600	457	1965	1908	778	1832	2174
PBN	2281	1735	1737	1594	1363	1401	1968	1399	2221	1298	2720	444	2088	2084	891	1948	2373
PDA	780	1276	1159	1489	1108	1269	1767	2060	816	668	1105	1761	1007	245	1232	1033	176
PDE	1182	1191	1237	1537	1099	1301	1648	1342	1165	303	1530	1491	1277	688	1035	1251	776
PNE	2096	1494	1485	1382	1103	1168	921	1284	1940	1027	2466	336	1818	1797	624	1681	2141
PAN	1511	1285	1217	1624	892	1064	1321	1562	1419	280	1886	935	1395	1117	589	1305	1572
SHI	734	1742	1648	2022	1872	1982	2354	2649	955	1874	486	2790	1230	1010	2228	1381	1173
SEA	1229	2074	1957	2317	1967	2152	2437	2860	1401	1425	1576	2597	1683	922	2991	1767	151
SHF	738	661	444	509	467	381	1129	1309	536	1486	899	1772	263	1066	1293	273	1786
SHS	1783	865	817	641	674	552	221	182	1561	1520	2065	849	1293	1792	794	1197	2764
SHI	1542	2382	1947	2347	2119	2243	2428	2943	1268	1917	899	2962	1566	1111	2466	1563	959
SHI	809	663	503	702	445	508	1023	1216	744	671	1273	1165	661	744	665	761	1765
SHI	1474	2097	2196	2568	2214	2384	2901	3114	1595	1700	1446	2873	1889	1164	2964	1985	821
SHI	618	477	319	732	537	632	1202	1254	414	985	952	1479	294	876	936	211	1519
SHI	1655	676	740	389	649	479	372	284	1433	1439	1937	882	1165	1672	746	1079	2212
SHI	1443	444	529	168	442	291	682	466	1224	1393	1718	1045	947	1510	777	794	2117
SHI	1446	639	703	408	582	352	213	411	1379	1294	1899	775	1130	1553	590	472	2176
SHI	2131	1609	1621	1273	1660	1073	725	1065	1954	1195	2490	97	1746	1891	617	1647	2266

LOC	GSB	GUS	HIF	HMN	HST	IAB	LFI	LIZ	LRF	LSV	LUF	MCC	MCF	MEM	MIB	MIT	MUO
ABQ	1943	1397	606	209	2029	644	2017	2584	970	590	426	1025	1807	1136	1140	1651	886
AEX	1073	868	1520	971	1008	608	1204	2028	278	1612	1402	2044	785	370	1518	1129	1808
BAD	1114	828	1405	885	1117	491	1232	2018	207	1511	1311	1939	889	346	1408	1098	1692
BIX	866	856	1782	1250	735	835	1018	1908	434	1891	1682	2321	506	402	1692	1080	2067
BYH	809	458	1496	1158	1081	526	898	1641	191	1704	1555	2097	841	46	1268	722	1765
CBM	746	597	1657	1237	886	684	869	1700	279	1828	1653	2238	646	163	1469	832	1933
CHS	277	765	2194	1813	600	1228	454	1405	849	2398	2230	2798	448	690	1853	829	2458
COF	616	1087	2364	1867	236	1394	792	1739	984	2504	2299	2928	152	865	2133	1186	2643
CVS	1740	1234	789	244	1803	481	1824	2443	759	815	627	1250	1581	928	1167	1498	1078
DLH	1301	622	1243	1457	1923	817	1251	1394	989	1654	1672	1889	1697	963	530	663	1400
DMA	2275	1763	747	315	2264	1008	2362	2958	1290	454	156	891	2057	1462	1459	2021	962
DOV	355	696	2289	2126	1193	1427	179	778	1174	2597	2497	2936	1074	1002	1717	528	2509
DYS	1527	1118	1083	458	1510	453	1631	2341	547	1109	889	1549	1294	721	1329	1394	1374
FEW	1813	1156	441	717	2119	563	1841	2234	975	792	819	1086	1880	1093	625	1361	695
FFO	553	151	1738	1580	1205	869	546	1155	671	2036	1939	2381	999	520	1251	256	1970
FWH	1370	991	1185	614	1368	407	1477	2210	397	1250	1042	1685	1147	569	1330	1267	1476
GPA	2292	1591	516	1265	2719	1182	2280	2432	1583	955	1160	958	2479	1673	556	1719	437
GSB	0	703	2252	1964	842	1317	178	1120	986	2504	2364	2880	719	813	1804	672	2499
GUS	703	0	1595	1477	1314	755	694	1223	624	1905	1820	2240	1097	499	1104	276	1823
HIF	2252	1595	0	798	2515	973	2282	2635	1381	466	644	653	2280	1514	950	1792	291
HMN	1964	1477	798	0	1960	725	2055	2687	978	682	434	1132	1748	1151	1338	1742	1067
HST	842	1314	2515	1960	0	1556	1014	1951	1144	2618	2394	3052	240	1047	2339	1422	2799
IAB	1317	755	973	725	1556	0	1378	1962	412	1187	1070	1571	1317	541	933	1017	1249
LFI	178	694	2282	2055	1014	1378	0	952	1084	2562	2442	2921	897	910	1770	594	2516
LIZ	1130	1223	2635	2687	1951	1962	952	0	1826	3026	2995	3283	1849	1671	1877	949	2791
LRF	986	624	1381	978	1144	412	1084	1826	0	1551	1385	1958	905	175	1266	896	1660
LSV	2504	1905	466	682	2618	1187	2562	3026	1551	0	301	450	2397	1710	1309	2134	571
LUF	2364	1820	644	434	2394	1070	2442	2995	1285	301	0	736	2182	1554	1413	2070	832
MCC	2880	2240	653	1132	3052	1571	2921	3283	1958	450	736	0	2827	2109	1449	2444	525
MCF	719	1097	2280	1748	240	1317	897	1849	905	2397	2182	2827	0	808	2103	1230	2562
MEM	813	499	1514	1151	1047	541	910	1671	175	1710	1554	2109	808	0	1306	760	1787
MIB	1804	1104	850	1338	2339	933	1770	1877	1266	1309	1413	1449	2103	1306	0	1190	922
MIT	672	276	1792	1742	1422	1917	594	949	496	2134	2070	2444	1230	760	1190	0	1997
MUO	2499	1823	291	1067	2799	1249	2516	2791	1660	571	832	525	2562	1785	932	1997	0
NIP	496	906	2210	1751	411	1237	674	1626	832	2371	2179	2789	229	700	1954	1014	2484
NFO	504	245	1939	1791	1229	988	162	1636	791	1448	2057	2485	1037	636	1341	193	2064
NON	949	1568	2498	1913	119	1559	1115	2678	1142	2579	2146	3018	271	1062	2465	1494	2714
OFF	1264	596	999	993	1678	323	1284	1725	585	1321	1270	1644	1439	633	681	813	1236
OGS	842	366	1736	1763	1581	1040	742	931	983	2104	2064	2390	1384	865	1077	164	1924
PAM	690	853	1978	1477	544	1014	856	1784	601	2110	1908	2535	304	508	1812	1938	2260
PHG	808	849	2324	2322	1649	1597	635	379	1447	2693	2644	2977	1521	1292	1619	579	2502
PUM	792	987	2506	2464	1611	1742	614	340	1555	2864	2862	3159	1510	1591	1817	732	2692
ROA	1774	1082	576	978	2195	668	1776	2961	1055	1002	1049	1223	1945	1128	360	1245	712
RTE	1586	890	1003	1264	2154	435	1546	1667	1124	1442	1506	1631	1921	1141	227	963	1126
RME	674	797	2221	2183	1516	1460	598	534	1295	2576	2516	2875	1378	1138	1552	446	2442
SAW	1093	487	1513	1647	1793	953	1018	1123	1012	1909	1903	2162	1581	937	803	424	1679
SHO	2679	2101	686	777	2737	1363	2746	3240	1709	224	344	452	2523	1875	1532	2339	750
SEA	2679	1940	624	1422	3034	1482	2639	2769	1891	941	1297	778	2795	1995	991	2071	374
SEF	1746	1242	1325	611	1371	679	1660	2443	622	1232	1038	1742	1176	772	1361	1117	1614
SH	228	682	2139	1787	686	1179	797	1341	414	2157	2139	2759	523	646	1775	741	2349
SHI	2913	2266	689	1143	3079	1544	2446	3111	1473	463	744	29	2946	2110	1478	1478	714
SIL	1076	490	1130	984	1421	265	1125	1307	132	1448	1774	1904	1133	376	944	155	1474
TOY	2419	2211	306	1531	3282	1717	2965	3037	2139	1019	1342	3044	2250	1177	2447	51	
TIF	1327	843	1070	648	1565	176	1419	2067	154	1197	104	1608	1232	517	1104	1116	1114
VAC	543	846	2087	1623	486	1114	715	1673	797	2243	2071	2661	261	582	1855	976	2164
VFC	731	816	1910	1405	693	947	892	1808	536	2038	1856	2464	371	454	1760	1431	2182
WFB	460	688	1996	1584	629	1024	629	1544	630	2130	2094	2587	410	482	1723	828	2267
WFI	451	743	2326	2193	1285	1486	273	681	1250	2647	2556	2976	1170	1081	1725	544	2579

LOC	NIP	NKO	NQX	OFF	OSC	PAM	PBG	PSM	RCA	RDR	RME	SAW	SBD	SKA	SKF	SSC	SUU
ABQ	1783	1632	1993	864	1653	1520	2227	2381	780	1182	2096	1511	739	1229	738	1783	1042
AEX	783	997	980	845	1233	506	1650	1735	1276	1391	1494	1285	1742	2074	461	865	2062
BAD	868	982	1093	740	1189	600	1638	1737	1159	1287	1485	1217	1648	1957	434	917	1957
BIX	512	916	718	1011	1212	230	1538	1594	1489	1537	1382	1324	2022	2317	709	643	2340
BYH	725	605	1098	598	824	545	1261	1365	1108	1099	1108	892	1872	1967	808	654	2119
CBM	553	680	899	796	957	345	1324	1401	1299	1301	1168	1064	1982	2152	791	552	2258
CHS	221	638	686	1246	993	430	1073	1068	1767	1648	931	1221	2558	2637	1329	88	2820
COF	182	994	324	1485	1349	394	1425	1399	2000	1942	1288	1562	2639	2860	1309	450	2948
CVS	1561	1460	1768	755	1519	1296	2078	2221	816	1165	1940	1410	955	1401	536	1572	1268
DLH	1520	799	1967	494	548	1431	1105	1298	668	303	1027	280	1874	1425	1486	1303	1917
DMA	2065	1994	2212	1239	2028	1790	2600	2750	1105	1530	2466	1886	486	1336	899	2101	899
DOV	849	451	1294	1292	653	1014	457	444	1761	1491	336	935	2790	2597	1772	564	2962
DYS	1293	1319	1470	776	1447	1019	1965	2088	1007	1277	1818	1395	1230	1683	263	1339	1566
FEW	1792	1400	2112	560	1318	1576	1908	2084	265	688	1797	1117	1010	922	1066	1705	1111
FFO	794	123	1268	739	399	788	776	891	1232	1035	624	589	2228	2091	1293	549	2406
FWH	1137	1181	1334	722	1332	866	1832	1948	1033	1251	1683	1305	1381	1767	278	1181	1703
GFA	2364	1818	2724	1055	1620	2176	2174	2370	536	776	2101	1352	1159	352	1706	2229	986
GER	496	504	940	1264	832	690	808	792	1774	1586	674	1093	2679	2639	1533	229	2903
GUC	906	245	1368	596	366	858	849	987	1082	890	707	487	2101	1940	1242	682	2266
HIF	2210	1839	2498	999	1736	1978	2324	2506	576	1003	2221	1513	686	624	1325	2139	680
HMN	1751	1701	1913	993	1763	1477	2322	2464	978	1364	2183	1647	777	1422	611	1787	1145
HOT	411	1229	119	1678	1585	544	1649	1611	2185	2154	1516	1793	2737	3034	1371	686	3070
IAB	1237	988	1550	323	1040	1014	1597	1742	668	845	1460	953	1368	1482	679	1179	1594
LEI	674	462	1115	1284	742	856	635	614	1776	1546	508	1018	2746	2630	1660	397	2946
LIC	1626	1036	2058	1725	931	1784	379	340	2061	1667	534	1123	3240	2769	2448	1341	3311
LSE	832	791	1142	585	983	601	1447	1555	1055	1124	1295	1012	1709	1891	622	814	1979
LEV	2371	2148	2579	1321	2104	2110	2693	2864	1002	1442	2576	1909	224	941	1292	2357	463
LVE	1779	2057	2346	1270	2064	1908	2644	2802	1069	1506	2516	1903	344	1207	1038	2199	744
MFC	2788	2485	3018	1645	2390	2535	2977	3159	1223	1631	2875	2162	452	778	1742	2750	29
MOT	228	1037	271	1439	1389	304	1521	1510	1945	1921	1378	1581	2523	2795	1176	523	2846
MRY	700	636	1062	633	865	508	1292	1391	1138	1141	1138	937	1875	1995	779	653	2124
NIB	1954	1311	2265	681	1077	1812	1619	1817	360	227	1552	803	1532	901	1585	1775	1478
NTO	1014	193	1494	813	164	1038	579	732	1245	963	446	424	2338	2071	1517	741	2478
NVO	2484	2064	2784	1236	1924	2260	2502	2692	752	1126	2412	1679	750	376	1614	2399	554
ORP	0	822	480	1311	1176	283	1294	1289	1828	1761	1151	1383	2515	2692	1222	226	2903
ORV	822	0	1301	341	156	854	656	769	1319	1089	364	793	2343	2169	1412	550	2711
ORV	480	1301	0	1645	1655	555	1748	1718	2193	2187	1612	1952	2649	3032	1514	265	3037
PIB	1311	341	1695	0	794	1141	1378	1543	321	547	1256	655	1526	1391	998	1179	167
POB	1176	356	1655	794	0	1186	590	770	1174	850	488	283	2315	1971	1593	661	2417
POM	281	354	754	1141	1186	0	1427	1457	1643	1637	1274	1344	2247	2491	947	462	2554
POM	1244	656	1748	1378	590	1427	0	201	1757	1398	156	825	2902	2520	2968	1081	3034
POM	1179	769	1718	1543	770	1457	201	0	1943	1394	287	1019	3069	2718	2170	1808	3136
POM	1328	1319	2193	521	1174	1643	1757	1943	0	442	1662	939	1225	870	1269	1649	127
POM	1761	1689	2187	547	850	1637	1398	1594	442	0	1326	577	1696	1125	1520	1568	1659
POM	1151	504	1612	1256	488	1274	156	287	1662	1326	0	749	2782	2451	1316	876	2902
POM	1383	593	1852	655	283	1344	825	1019	939	577	749	0	2126	1702	1580	1134	2193
POM	2515	2343	2689	1526	2315	2247	2902	3069	1225	1666	2782	2126	0	1102	1381	2322	47
POM	2692	2169	3032	1391	1971	2491	2520	2718	870	1125	2451	1702	1102	0	1947	2569	892
POM	1229	1412	1314	998	1593	937	2968	2170	1269	1529	1916	1380	1381	1345	0	145	1557
POM	226	556	769	1178	901	462	1001	1008	1699	1563	859	1114	2522	2569	1925	0	277
POM	2333	2541	3045	1678	2417	2554	3004	3186	1276	1679	2902	2169	47	0	1775	277	
POM	1461	724	1487	260	790	884	1335	1478	764	792	1196	743	1624	1627	0	961	1427
POM	1949	2444	3275	1657	2247	2740	2794	2992	1139	1409	2726	1377	1417	226	2101	2497	74
POM	1180	1078	1449	404	1124	933	1692	1825	820	1020	1749	1101	1357	1708	765	1345	142
POM	124	786	112	1292	1154	166	1311	1325	1716	1663	1162	1321	2487	2576	1693	31	247
POM	722	851	611	1686	1177	72	1445	1485	1583	1591	1291	1119	2174	2427	800	54	248
POM	211	639	681	1081	993	240	1188	1217	1600	1531	1046	1171	2334	2466	1097	245	2609
POM	966	500	1387	1334	649	1111	369	347	1788	1497	263	931	2843	2613	1854	661	3032

LOC	SZL	TCM	TIK	VAD	VPS	WRB	WRI
ABQ	909	1404	618	1655	1448	1596	2131
AEX	603	2307	477	656	434	639	1409
BAD	508	2190	359	740	528	703	1421
BIX	752	2558	732	389	160	408	1253
BYH	343	2224	517	609	493	502	1060
CBM	538	2404	632	430	291	352	1073
CHS	1020	2901	1202	272	482	233	725
COF	1236	3114	1324	284	466	411	1065
CVS	744	1595	414	1433	1224	1379	1954
DLH	671	1700	985	1439	1393	1294	1195
DMA	1273	1446	952	1937	1718	1899	2490
DOV	1165	2873	1479	882	1045	775	97
DYS	661	1889	294	1165	947	1130	1794
FEW	744	1164	676	1672	1510	1573	1891
FFO	605	2364	936	740	777	590	617
FWH	561	1985	231	1009	794	972	1647
GFA	1300	628	1316	2252	2115	2136	2260
GSB	1076	2910	1327	543	731	460	451
GUS	490	2213	843	836	836	688	743
HIF	1180	806	1050	2087	1910	1996	2326
HMN	988	1581	648	1623	1405	1584	2193
HST	1423	3282	1465	486	608	629	1285
IAB	265	1727	176	1114	947	1024	1486
LFI	1125	2905	1410	715	892	620	273
LIZ	1703	3037	2065	1658	1808	1544	681
LRF	332	2139	354	707	536	630	1250
LSV	1438	1010	1197	2243	2038	2180	2647
LUF	1334	1302	1038	2051	1836	2004	2556
MCC	1804	721	1608	2661	2464	2587	2976
MCT	1183	3044	1232	261	371	410	1170
MFM	376	2250	517	582	454	482	1091
MIB	940	1175	1104	1855	1760	1723	1725
MTC	755	2347	1116	976	1031	828	544
MUO	1438	518	1336	2363	2192	2267	2539
NIP	1065	2949	1180	128	352	231	946
NKO	723	2144	1038	786	353	639	500
NOX	1537	3275	1549	532	611	681	1387
OFF	260	1657	494	1202	1036	1081	1334
OSC	790	2247	1159	1134	1175	985	649
PAM	884	2740	933	166	72	240	1111
PRG	1335	2794	1692	1311	1445	1188	369
PSM	1478	2992	1825	1325	1485	1217	347
RCA	764	1138	820	1716	1583	1600	1798
REF	792	1400	1020	1668	1591	1531	1497
RNE	1196	2726	1549	1162	1291	1036	265
SAW	743	1977	1101	1321	1319	1171	931
SBR	1626	1125	1357	2387	2174	2334	2843
SFA	1627	276	1593	2576	2427	2466	2613
SFI	837	2131	595	1098	849	1097	1854
SIT	961	2435	1195	418	504	235	661
SJT	1927	740	1628	2681	2481	2408	3002
SOL	0	1096	164	972	427	879	1222
SVV	1096	0	1031	2831	2674	2725	2889
TIE	569	1831	0	1055	565	983	1546
VAD	872	2841	1953	0	279	150	979
VPS	827	2674	863	239	0	272	1140
WRB	839	2725	983	150	272	0	871
WRI	1222	2849	1546	979	1140	871	0

Combined Surface Inter-locational air statute mileage

	ABQ	AEX	BAD	BIX	BYH	CRM	CHS	COP	CVS	DAG	DCA	DLH	DMA	DOV	DYS	FEW	PFO
ABQ	0	852	767	1084	945	1037	1516	1595	188	1632	1634	1084	313	1726	437	430	1261
AEX	852	0	98	234	341	281	727	748	664	991	1002	1056	1070	1102	427	960	738
BAD	767	98	0	319	315	307	779	828	580	1006	1015	982	999	1115	356	862	721
BIX	1084	234	319	0	372	217	526	514	896	855	869	1137	1302	967	661	1163	687
BYH	945	341	315	372	0	168	584	744	776	715	721	765	1223	819	613	892	406
CRM	1037	281	307	217	168	0	481	592	857	711	721	927	1292	822	656	1036	482
CHS	1516	727	779	526	584	481	0	304	1337	425	445	1155	1773	523	1134	1470	529
COP	1595	748	828	514	744	592	304	0	1408	720	741	1418	1815	809	1175	1628	911
CVS	188	664	580	896	776	857	1337	1408	0	1477	1479	1025	449	1574	252	478	1116
DAG	1632	991	1006	855	715	711	425	720	1477	0	21	956	1925	112	1328	1468	386
DCA	1634	1002	1015	869	721	721	445	741	1479	21	0	943	1928	101	1334	1464	383
DLH	1084	1056	982	1137	765	927	1155	1418	1025	956	943	0	1391	991	1058	721	632
DMA	313	1070	999	1302	1223	1292	1773	1815	449	1925	1928	1391	0	2022	643	703	1561
DOV	1726	1102	1115	967	819	822	523	809	1574	112	101	991	2022	0	1432	1543	468
DYS	437	427	356	661	613	656	1134	1175	252	1328	1334	1058	643	1432	0	669	997
FEW	430	960	862	1163	892	1036	1470	1628	478	1468	1464	721	703	1543	669	0	1082
PFO	1261	738	721	687	406	482	529	811	1116	386	383	632	1561	468	997	1082	0
FWH	551	302	225	535	489	524	1002	1049	363	1203	1209	1006	774	1308	132	717	882
GFA	882	1489	1391	1678	1369	1528	1916	2113	991	1820	1810	895	1049	1871	1204	539	1452
GON	1897	1318	1325	1190	1021	1038	741	1016	1755	335	321	1058	2200	224	1630	1676	639
GSB	1619	894	928	722	675	622	231	514	1450	209	231	1084	1896	296	1272	1510	461
GUS	1164	723	690	713	382	498	637	906	1028	507	501	518	1469	580	932	963	125
HIF	505	1267	1171	1485	1246	1381	1829	1970	658	1834	1830	1036	622	1908	903	367	1448
HMN	174	809	737	1042	965	1031	1511	1556	204	1673	1676	1214	262	1772	382	597	1316
HST	1691	840	931	612	901	739	500	197	1503	910	931	1603	1886	994	1259	1765	1004
IAB	537	507	409	696	439	570	1023	1162	401	1097	1098	681	840	1139	377	469	724
IND	1148	665	637	648	325	433	586	847	1005	498	495	573	1450	581	895	972	114
INH	1632	994	1009	859	716	713	431	727	1477	7	15	952	1926	109	1329	1466	385
KBY	1478	649	717	426	589	449	164	173	1294	588	608	1245	1716	687	1073	1480	639
LEI	1681	1003	1027	848	748	724	378	660	1520	91	109	1042	1968	149	1359	1534	455
LEH	680	1509	1433	1742	1625	1714	2144	2257	858	2304	2304	1633	451	2394	1082	913	1924
LIT	2153	1690	1681	1590	1367	1417	1171	1449	2036	753	735	1162	2465	648	1951	1862	902
LEF	809	232	173	361	159	233	707	820	432	873	879	825	1075	978	456	812	554
LOV	492	1343	1259	1574	1420	1523	1999	2087	680	2079	2078	1378	379	2164	924	660	1647
LUB	355	1169	1093	1482	1296	1378	1859	1916	522	1987	1989	1393	130	2081	741	682	1614
MCI	854	1504	1615	1934	1743	1865	2332	2440	1042	2370	2367	1574	743	2447	1291	905	1944
MDF	1595	654	741	422	791	539	373	127	1318	798	819	1415	1714	895	1073	1567	492
MEN	946	908	289	335	18	136	575	721	774	728	735	802	1218	835	601	911	447
MIB	950	1265	1173	1419	1056	1224	1544	1778	973	1391	1379	442	1216	1431	1104	521	1040
MTG	1375	941	915	960	602	694	691	988	1248	406	392	552	1685	440	1162	1134	213
MTO	738	1097	1410	1723	1471	1611	2048	2202	898	2025	2019	1167	802	2091	1145	579	1642
NOJ	1942	1361	1369	1230	1065	1080	774	1044	1800	375	362	1096	2245	263	1675	1720	687
NEL	727	1568	1478	1797	1597	1718	2181	2299	912	2212	2208	1415	665	2288	1164	745	1427
NOE	1636	995	1022	834	744	717	353	630	1523	122	141	1067	1971	180	1357	1548	472
NOZ	893	1744	1658	1976	1801	1914	2384	2485	1081	2433	2430	1648	754	2512	1327	971	2047
NOF	1675	1029	1046	888	756	749	443	731	1519	42	47	989	1967	82	1369	1509	429
NIP	1486	953	723	426	604	461	134	152	1301	609	629	1266	1721	708	1977	1434	862
NLD	1440	431	813	763	704	767	532	828	1217	306	299	666	1662	376	1049	1167	102
NFT	1634	943	982	759	734	676	243	496	1513	254	275	1157	1958	221	1373	1147	557
NOV	745	1595	1512	1828	1671	1777	2251	2340	932	2322	2320	1581	587	2405	1174	873	1944
NOA	1147	912	894	91	397	223	452	437	973	799	814	1153	1382	919	740	1224	447
NOR	1641	417	911	598	915	349	572	230	1473	990	1011	1640	1843	1078	1425	1760	1174
NTJ	725	1562	1483	1795	1668	1761	2241	2309	906	2340	2339	1446	512	2427	1135	924	1944
NOV	1222	1077	1060	2163	1876	2029	2453	2620	1377	2345	2335	1411	1269	2394	1619	1000	1977
NOW	649	1467	1399	1713	1585	1673	2153	2214	816	2266	2267	1605	408	2356	1619	804	1844
NZY	643	1453	1380	1685	1586	1667	2148	2199	812	2274	2275	1637	385	2366	1626	916	1844
OFB	720	704	617	943	498	663	1038	1237	630	1002	997	412	1033	1077	647	466	614
ONJ	1378	1928	991	1010	686	798	828	1124	1266	528	512	456	1699	544	1206	1098	312

	ABQ	AEX	BAD	BIX	BYH	CBM	CHS	COP	CVS	DAG	DCA	DLH	DMA	EOV	DYS	FFW	FFO
PAM	1267	422	500	191	454	288	358	328	1080	736	753	1192	1492	845	849	1314	656
PBG	1856	1375	1365	1282	1051	1103	894	1187	1731	469	449	921	2166	381	1638	1590	646
PHL	1737	1127	1137	996	838	846	558	844	1588	141	127	981	2035	36	1451	1545	477
PNE	1737	1127	1137	996	838	846	558	844	1588	141	127	981	2035	36	1451	1545	477
PSM	1984	1446	1447	1328	1138	1168	890	1166	1851	478	462	1082	2291	370	1740	1737	743
PWT	1185	1934	1837	2142	1862	2013	2425	2604	1344	2346	2337	1419	1222	2398	1587	980	1975
RCA	650	1063	966	1240	923	1083	1472	1667	680	1406	1398	556	920	1467	839	221	1026
RDR	985	1159	1073	1281	916	1084	1373	1618	971	1204	1192	252	1275	1242	1064	574	863
RME	1747	1245	1237	1152	923	973	776	1074	1617	353	332	856	2055	280	1515	1498	520
SAW	1259	1071	1014	1104	743	886	1018	1302	1175	759	743	233	1572	779	1163	931	491
SBD	616	1452	1373	1685	1560	1652	2132	2199	796	2236	2236	1562	405	2325	1025	842	1857
SKA	1024	1729	1630	1930	1639	1793	2197	2383	1168	2113	2104	1187	1114	2164	1403	769	1742
SKF	615	384	362	591	673	659	1108	1090	447	1367	1376	1238	749	1476	219	888	1078
SOC	1486	721	764	536	545	460	73	375	1310	367	386	1086	1750	470	1116	1421	458
SOU	868	1719	1631	1950	1766	1882	2350	2457	1056	2391	2388	1597	749	2468	1305	926	2005
SZL	757	503	424	627	286	449	850	1030	620	881	881	560	1061	971	551	620	504
TCM	1170	1923	1825	2131	1854	2003	2418	2595	1329	2342	2335	1417	1205	2394	1574	970	1970
TIK	515	397	299	610	431	526	1002	1103	345	1133	1137	820	793	1232	245	564	780
TWH	1686	993	1021	832	749	716	349	625	1523	127	146	1071	1971	185	1357	1550	474
VAD	1379	547	616	324	508	358	227	236	1194	629	848	1199	1614	735	971	1394	617
VPC	1207	362	440	123	411	243	402	388	1020	760	776	1161	1431	871	789	1259	648
WRB	1330	533	586	340	419	293	194	343	1149	536	553	1079	1582	646	941	1311	492
WRI	1775	1174	1184	1044	883	394	604	888	1628	190	175	995	2075	81	1495	1576	515

	FWH	GFA	GON	GSB	GUS	HIF	HMN	HST	IAB	IND	INH	KBY	LFI	LGB	LIZ	LRF	LEV
ABQ	551	882	1897	1619	1164	505	174	1691	537	1148	1632	1478	1681	680	2153	809	492
AEX	302	1489	1318	894	723	1267	809	840	507	665	994	649	1003	1509	1690	232	1344
BAD	225	1391	1325	928	690	1171	737	931	409	637	1009	717	1027	1433	1681	173	1259
BIX	535	1678	1190	722	713	1485	1042	612	696	648	859	426	848	1742	1590	361	1576
BYH	489	1369	1021	675	382	1246	965	901	439	325	716	589	748	1625	1367	159	1420
CEM	524	1528	1038	622	498	1381	1031	739	570	433	713	449	724	1714	1417	233	1523
CHS	1002	1916	741	231	637	1829	1511	500	1023	586	431	164	378	2194	1171	707	1999
COF	1049	2113	1016	514	906	1970	1556	197	1162	847	727	173	660	2257	1449	820	2087
CVS	363	991	1755	1450	1028	658	204	1503	401	1005	1477	1294	1520	858	2036	632	680
DAG	1203	1820	335	209	507	1834	1673	910	1097	498	7	588	91	2304	753	873	2079
DCA	1209	1810	321	231	501	1830	1676	931	1098	495	15	608	109	2304	735	879	2078
DLH	1006	895	1058	1084	518	1036	1214	1603	681	573	952	1245	1042	1633	1162	825	1378
DMA	774	1049	2200	1896	1469	622	262	1886	840	1450	1926	1716	1968	451	2465	1075	379
DOV	1308	1871	224	296	580	1908	1772	994	1189	581	109	687	149	2394	648	978	2144
DYS	132	1204	1630	1272	932	903	382	1259	377	895	1329	1073	1359	1082	1951	456	924
FEW	717	539	1676	1510	963	367	597	1765	469	972	1466	1480	1534	913	1862	812	660
EFO	882	1452	639	461	125	1448	1316	1004	724	114	385	639	455	1926	962	559	1647
FWH	0	1255	1509	1142	826	988	512	1140	339	784	1204	942	1231	1209	1841	331	1042
GFA	1255	0	1953	1910	1326	430	1054	2266	985	1357	1816	1953	1900	1024	2027	1319	736
GON	1509	1953	0	511	734	2035	1956	1194	1381	750	331	905	363	2553	433	1180	2316
GSB	1142	1910	511	0	586	1877	1637	702	1097	554	216	394	148	2298	942	822	2087
GUS	826	1326	734	586	0	1329	1231	1095	630	66	504	733	579	1821	1019	520	1587
HIF	988	430	2035	1877	1329	0	665	2096	811	1339	1832	1829	1901	637	2196	1151	388
HMN	512	1054	1956	1637	1231	665	0	1633	604	1206	1673	1454	1713	702	2239	815	568
HST	1140	2266	1194	702	1095	2096	1633	0	1296	1034	917	365	845	2334	1626	953	2181
IAB	339	985	1361	1097	620	811	604	1296	0	611	1097	1018	1149	1208	1635	343	990
IND	784	1357	750	554	66	1339	1206	1034	611	0	496	673	563	1812	1058	469	1583
INH	1204	1816	331	216	504	1832	1673	917	1097	496	0	594	97	2304	747	874	2078
KBY	942	1953	905	394	723	1829	1454	365	1018	673	594	0	542	2149	1335	682	1967
LFI	1231	1900	363	148	579	1901	1213	845	1149	563	97	542	0	2356	793	904	2155
LGB	1209	1024	2553	2298	1821	637	702	2334	1208	1812	2304	2149	2356	0	2771	1488	256
LIZ	1841	2027	433	942	1019	2196	2239	1626	1058	747	1335	793	2771	0	1522	2521	0
LRF	331	1319	1180	822	520	1151	815	953	343	469	874	682	904	1488	1522	0	1292
LEV	1042	736	2316	2087	1587	388	568	2181	990	1583	2078	1967	2135	256	2521	1292	0
LFE	169	966	2250	1970	1517	517	362	1995	892	1502	1987	1810	2035	341	2496	1154	251
MCF	1454	798	2579	2460	1367	745	943	2545	1310	1873	2369	2113	2444	393	2736	1632	357
MDF	955	2066	1109	599	914	1960	1457	200	1098	852	804	212	744	2159	1541	754	1907
MEH	474	1394	1040	678	416	1261	959	873	451	357	730	269	758	1627	1293	145	1427
MIB	1109	663	1498	1504	920	709	1115	1949	778	962	1357	1609	1475	1544	1564	1055	1446
MTF	1056	1532	542	560	239	1493	1452	1185	858	278	401	822	495	2019	791	747	1778
MVO	1230	964	2202	2083	1519	243	859	2332	1041	1536	2023	2057	2097	676	2326	1383	176
MVO	1456	1992	45	543	779	2078	1891	1218	1406	796	371	937	496	2598	408	1224	2361
NEL	1272	665	2448	2245	1708	394	845	2408	1153	1715	2210	2168	2276	403	2576	1446	247
NEL	1229	1920	189	123	596	1915	1714	814	1156	577	128	716	33	2362	821	903	2144
NEL	1444	379	2647	2458	1932	616	969	2583	1364	1936	2442	2361	2496	357	2810	1642	407
NIB	1244	1857	305	213	547	1857	1715	919	1119	540	43	606	77	2347	729	914	2121
NIB	1438	1679	924	414	777	1941	1479	342	1031	646	616	23	562	2156	1355	643	1976
NIB	994	1517	538	429	294	1472	1419	1024	823	212	303	661	385	2622	863	660	1769
NIB	1109	1934	576	21	660	1449	1643	675	1166	629	261	394	174	2364	954	667	2144
NIB	1094	1663	2579	2460	1367	745	943	2545	1310	1873	2369	2113	2444	393	2736	1632	357
NIB	919	1732	1134	657	56	1452	1132	544	713	659	94	34	746	1421	1432	414	1844
NIB	1111	2270	144	21	1140	244	1544	39	1292	1047	907	424	929	2293	1715	632	2144
NIB	1241	1437	2545	2460	1367	745	943	2545	1310	1873	2369	2113	2444	393	2736	1632	357
NIB	1647	157	2460	144	1852	709	134	2764	1468	1891	244	2464	2425	1049	2149	1411	94
NIB	1146	1916	2517	219	144	621	649	2293	1109	1737	2266	2107	2317	43	2379	1447	21
NIB	1145	1914	2517	2200	1708	671	644	2271	1127	1736	2274	2097	2123	92	2763	1444	247
NIB	662	1879	1216	1877	497	843	827	1198	269	507	1040	1075	1073	1142	1432	443	1151
NIB	1110	1450	664	694	303	1447	1469	1120	867	366	522	357	619	2000	776	819	1777

	FWH	GFA	GON	GGB	GGS	HIT	HMH	HET	IAB	IND	INH	KBY	LEI	LGB	LIZ	LRP	LSV
PAM	722	1813	1069	575	715	1649	1231	453	855	650	761	237	713	1930	1487	501	1759
PBG	1527	1811	228	675	708	1937	1935	1375	1331	755	463	1057	529	2489	316	1206	2255
PHL	1328	1865	195	331	585	1909	1786	1030	1200	590	137	722	185	2402	615	997	2171
PNE	1328	1865	195	331	585	1909	1786	1030	1200	590	137	722	185	2402	615	997	2171
PSM	1623	1925	150	660	823	2088	2053	1353	1552	859	473	1055	512	2628	283	1296	2386
PWT	1667	527	2577	2531	1850	686	1333	2755	1559	1877	2353	2551	2525	985	2529	1792	860
RCA	861	556	1576	1578	902	480	815	1821	557	925	1503	1507	1580	1091	1717	879	845
RDR	1053	657	1309	1322	757	836	1137	1795	705	788	1199	1557	1288	1558	1389	937	1202
RME	1502	1751	210	562	589	1851	1820	1265	1217	621	367	937	523	2389	555	1079	2157
SAW	1087	1127	829	911	506	1261	1373	1595	795	571	753	1129	858	1853	935	855	1591
SBG	1150	966	2583	2232	1751	572	658	2281	1150	1753	2245	2089	2289	71	2700	1525	187
SEA	1573	295	2256	2199	1617	520	1185	2529	1235	1656	2109	2227	2192	961	2307	1576	295
SKP	232	1521	1687	1278	1035	1105	509	1153	566	987	1369	1017	1383	1200	2050	519	1077
SSC	985	1858	692	190	568	1783	1589	572	982	519	373	225	331	2166	1118	678	1965
SWO	1519	822	2601	2520	1888	567	955	2558	1328	1895	2390	2330	2555	377	2759	1659	386
THL	568	1083	1150	897	509	983	823	1186	221	391	881	872	937	1523	1519	277	1198
TCM	1655	525	2525	2525	1855	672	1317	2735	1539	1872	2338	2552	2520	965	2531	1782	852
TIE	193	1096	1519	1106	707	875	550	1221	155	672	1135	973	1175	1195	1720	295	597
TWH	1228	1923	393	119	599	1917	1715	309	1156	579	133	512	39	2363	826	902	2155
VAP	351	1877	957	557	697	1739	1353	505	929	635	635	107	596	2059	1357	730	1969
VPC	661	1767	1095	610	697	1591	1171	507	789	631	765	293	753	1379	1507	556	1608
WRB	810	1780	870	885	573	1663	1329	525	851	511	551	175	517	2087	1287	525	1936
WRI	1372	1385	155	376	619	1939	1828	1071	1238	628	186	768	228	2539	567	1052	2296

	LUF	MCC	MCF	MEM	MIB	MTG	MUO	NCO	NFL	NGU	NGZ	NHK	NIP	NKO	NKT	NLC	NPA
ABQ	355	854	1505	946	950	1375	738	1942	727	1686	893	1675	1486	1360	1684	745	1160
AEX	1169	1704	654	308	1265	941	1507	1361	1568	995	1744	1029	653	831	943	1595	312
BAD	1093	1615	741	289	1173	915	1410	1369	1478	1022	1658	1046	723	818	982	1512	394
BIX	1402	1934	422	335	1410	900	1723	1230	1797	834	1976	888	426	763	759	1828	81
BYH	1296	1748	701	38	1056	602	1471	1065	1597	749	1801	756	604	504	739	1671	395
CBM	1378	1865	539	136	1224	694	1611	1080	1718	717	1914	749	461	567	676	1777	228
CHS	1859	2332	373	575	1544	691	2048	774	2181	353	2384	443	184	532	243	2251	452
COF	1916	2440	127	721	1778	938	2202	1044	2299	630	2485	731	152	828	496	2340	435
CYS	522	1042	1318	774	973	1248	898	1800	912	1523	1081	1519	1301	1217	1513	932	973
DAG	1987	2370	798	728	1391	406	2025	375	2212	122	2433	42	609	306	254	2322	799
DCA	1989	2367	819	735	1379	392	2019	362	2208	141	2430	47	629	299	275	2320	814
DLH	1393	1574	1415	802	442	552	1167	1096	1415	1067	1648	989	1266	666	1157	1581	1155
DMA	130	743	1714	1218	1216	1685	802	2245	665	1971	754	1967	1721	1662	1958	587	1382
DOV	2081	2447	895	835	1431	440	2091	263	2288	180	2512	82	708	376	321	2405	910
DYS	741	1291	1078	601	1108	1162	1145	1675	1164	1357	1327	1369	1077	1099	1330	1174	740
FEW	682	905	1567	911	521	1134	579	1720	745	1548	971	1509	1494	1167	1583	878	1224
FFO	1616	1984	832	433	1043	213	1642	685	1825	472	2047	428	662	102	535	1938	665
FWH	869	1404	955	474	1109	1056	1230	1554	1272	1229	1444	1244	948	984	1199	1294	613
GFA	966	798	2066	1394	463	1432	364	1992	665	1920	879	1857	1970	1515	1984	883	1732
GON	2250	2579	1109	1040	1498	542	2202	45	2418	389	2647	305	924	538	520	2550	1134
GJB	1970	2400	599	678	1504	560	2083	543	2245	123	2458	218	414	420	74	2336	655
GUS	1517	1867	914	416	920	230	1519	779	1708	596	1932	547	755	204	660	1826	705
HIF	537	545	1900	1261	709	1493	243	2078	384	1915	616	1875	1841	1532	1949	548	1552
HMN	362	943	1457	959	1115	1452	889	2001	835	1714	969	1715	1459	1418	1698	809	1122
HST	1995	2544	200	873	1949	1185	2332	1218	2408	814	2583	919	342	1024	675	2432	544
IAB	892	1310	1098	451	778	848	1041	1406	1158	1156	1364	1139	1031	823	1166	1239	755
IND	1502	1873	852	357	962	278	1536	796	1715	577	1936	540	695	212	628	1825	639
INH	1987	2369	804	730	1387	401	2023	371	2210	128	2432	43	616	303	261	2321	804
KBY	1810	2313	212	569	1609	822	2057	937	2168	516	2361	606	23	661	398	2221	345
LFI	2035	2434	748	758	1475	495	2097	396	2276	33	2496	77	562	385	174	2381	786
LGB	341	383	2159	1627	1344	2019	676	2598	403	2362	357	2347	2156	2022	2364	203	1821
LIE	2496	2736	1541	1393	1564	791	2326	408	2576	821	2810	729	1355	863	954	2737	1542
LEF	1156	1632	754	145	1055	747	1383	1224	1486	903	1682	914	693	660	883	1545	414
LSV	251	375	1997	1425	1090	1778	476	2361	287	2144	403	2121	1976	1790	2155	254	1602
LUF	0	613	1818	1295	1177	1725	693	2245	538	2039	625	2030	1816	1714	2034	460	1481
MCI	613	0	2356	1757	1208	2037	437	2622	161	2446	80	2412	2323	2071	2470	180	2044
MFI	1413	2356	0	673	1752	1025	2135	1139	2218	720	2398	815	190	865	593	2349	144
MEM	1295	1757	673	0	1089	633	1488	1084	1608	757	1809	769	583	530	740	1677	361
MIB	1177	1209	1752	1089	0	991	777	1535	1056	1498	1287	1426	1628	1092	1577	1270	1444
MTG	1725	2037	1025	633	991	0	1664	585	1876	522	2105	438	845	161	629	2010	878
MUO	693	437	2135	1488	777	1664	0	2244	301	2112	518	2065	2070	1725	2154	521	1788
NCO	2295	2622	1139	1084	1535	585	2244	0	2461	421	2690	343	956	584	548	2594	1174
NFL	538	161	2218	1609	1056	1376	301	2461	0	2288	234	2253	2178	1912	2316	224	1869
NGU	2039	2446	720	757	1498	522	2112	421	2288	0	2507	110	536	406	142	2340	773
NGZ	626	80	2398	1809	1287	2105	518	2690	234	2507	0	2475	2370	2136	2528	163	2012
NHK	2040	2412	815	769	1426	438	2065	343	2253	110	2475	0	627	346	251	2365	843
NIP	1916	2323	190	583	1628	845	2070	956	2178	136	2370	627	0	685	415	2229	141
NKO	1714	2071	865	530	1092	161	1720	584	1912	406	2136	346	685	0	432	2640	71
NKT	2114	2470	593	740	1577	628	2156	543	2316	142	2528	251	417	492	0	2444	674
NLC	745	1160	140	2149	1677	1250	1710	521	2594	224	2390	163	2365	2229	2045	2481	1447
NPA	1481	2099	349	361	1443	878	1788	1174	1869	779	2052	840	345	733	634	1947	555
NPH	1915	2415	224	385	1971	1245	2320	1308	2343	899	2452	1001	400	1044	742	2408	57
NTP	296	212	2113	1671	1342	2046	647	2627	361	2401	299	2382	224	2054	2406	146	1474
NW	1171	676	2764	1899	970	1954	585	2505	643	2445	738	2382	2480	2040	2500	441	221
NW	298	409	2116	1586	1325	1984	675	2562	415	2424	389	2309	2113	1985	2424	224	1774
NYS	299	473	2099	1585	1379	2002	737	2577	479	2328	449	2317	2103	1997	2324	293	1767
OFF	1059	1470	1199	527	568	677	1030	1261	1211	1084	1436	1043	1092	701	1127	1344	847
ORF	1720	1991	1158	721	899	137	1603	643	1831	647	2062	555	980	296	760	1977	444

	LUF	MCC	MCP	MEM	MIB	MTG	MUO	NCO	NFL	NGU	NGZ	NHK	NIP	NKO	NKT	NLC	NPA
PAM	1590	2113	254	423	1510	865	1883	1107	1972	694	2157	764	236	712	600	2012	110
PBG	2204	2481	1267	1077	1349	483	2085	239	2320	561	2552	456	1078	547	701	2468	1237
PHL	2092	2450	930	855	1422	432	2090	235	2290	216	2516	116	742	381	356	2411	940
PNE	2092	2450	930	855	1422	432	2090	235	2290	216	2516	116	742	381	356	2411	940
PSM	2335	2633	1259	1160	1514	610	2243	127	2472	538	2703	451	1074	641	670	2615	1276
PWT	1103	620	2547	1884	980	1959	447	2515	590	2445	681	2384	2466	2041	2505	785	2204
RCA	891	1019	1621	949	300	1038	627	1617	859	1498	1093	1445	1524	1099	1552	1026	1291
RDR	1255	1359	1601	951	189	803	938	1347	1202	1312	1436	1238	1467	907	1395	1384	1311
RME	2097	2396	1148	949	1293	372	2010	243	2235	456	2466	347	959	420	597	2376	1108
SAW	1586	1802	1318	781	669	354	1399	866	1642	876	1875	788	1152	494	980	1802	1104
SRD	286	376	2103	1562	1277	1948	625	2528	368	2295	365	2278	2096	1953	2299	199	1764
SKA	1006	649	2329	1662	751	1726	313	2284	561	2212	724	2150	2243	1808	2274	782	1989
SKF	865	1451	980	649	1321	1264	1345	1731	1336	1377	1479	1406	1017	1177	1326	1318	672
SSC	1832	2292	436	540	1479	618	1999	727	2140	310	2346	389	246	459	224	2216	467
SUU	620	24	2371	1775	1232	2059	461	2644	183	2466	57	2433	2340	2092	2490	177	2024
SZL	1112	1503	986	313	783	629	1199	1185	1348	946	1562	924	888	602	968	1444	667
TCM	1085	601	2537	1875	979	1956	432	2513	571	2440	663	2380	2457	2036	2500	767	2193
TIK	865	1340	1027	431	920	930	1113	1464	1196	1178	1388	1175	983	882	1170	1251	678
TWH	2040	2447	716	757	1502	526	2115	425	2290	6	2508	116	531	409	136	2391	768
VAD	1709	2217	217	485	1546	814	1969	992	2073	574	2264	653	107	655	470	2123	244
VPS	1530	2053	309	378	1467	859	1826	1133	1913	726	2097	790	294	711	640	1951	52
WRB	1670	2156	342	402	1436	690	1889	908	2008	500	2206	565	193	532	419	2070	271
WRI	2130	2480	975	901	1437	453	2116	187	2320	257	2547	163	788	417	396	2444	989

	NQX	NTD	NUW	NZJ	NZY	OFF	OSC	PAM	PRG	PHL	PNR	PSM	PWT	RCA	RDR	RME	SAW
ABQ	1661	725	1222	640	643	720	1378	1267	1856	1737	1737	1984	1185	650	985	1747	1259
AEX	817	1562	1958	1467	1453	704	1028	422	1375	1127	1127	1446	1934	1063	1159	1245	1071
BAD	911	1483	1860	1390	1380	617	991	500	1365	1137	1137	1447	1837	966	1073	1237	1014
BIX	598	1795	2163	1700	1685	843	1010	191	1282	996	996	1328	2142	1240	1281	1152	1104
BYH	915	1668	1876	1585	1586	498	686	454	1051	838	838	1138	1862	923	916	923	743
CBM	749	1761	2029	1673	1667	663	798	288	1103	846	846	1168	2013	1083	1084	973	886
CHS	572	2241	2435	2153	2148	1038	828	358	894	558	558	890	2425	1472	1373	776	1018
COP	270	2309	2620	2214	2199	1237	1124	328	1187	844	844	1166	2604	1667	1618	1074	1302
CVS	1473	906	1377	816	812	630	1266	1080	1731	1588	1588	1851	1344	680	971	1617	1175
DAG	990	2340	2345	2266	2274	1002	528	736	469	141	141	478	2346	1406	1204	353	759
DCA	1011	2339	2335	2267	2275	997	512	753	449	127	127	462	2337	1398	1192	332	743
DLH	1640	1646	1411	1605	1637	412	456	1192	921	981	981	1082	1419	556	252	856	233
DMA	1843	512	1269	408	385	1033	1690	1492	2166	2035	2035	2291	1222	920	1275	2055	1572
DOV	1078	2427	2394	2356	2366	1077	544	845	381	36	36	370	2398	1467	1242	280	779
DYS	1225	1135	1619	1039	1026	647	1206	849	1638	1451	1451	1740	1587	839	1064	1515	1163
FEW	1760	929	1000	884	916	466	1098	1314	1590	1545	1545	1737	980	221	574	1498	931
FEO	1056	1959	1977	1889	1900	616	332	656	646	477	477	743	1975	1026	863	520	491
FWH	1111	1261	1695	1166	1155	602	1110	722	1527	1328	1328	1623	1667	861	1043	1402	1087
GFA	2270	1002	525	1016	1074	879	1350	1813	1811	1864	1864	1975	527	446	647	1751	1127
GON	1282	2583	2468	2517	2532	1216	604	1069	228	194	194	150	2477	1576	1309	210	829
GGB	783	2340	2435	2259	2260	1053	694	575	674	331	331	660	2431	1478	1322	562	911
GUS	1140	1852	1852	1785	1798	497	305	715	708	585	585	823	1850	902	742	589	406
HIF	2081	633	720	621	671	833	1447	1649	1937	1909	1909	2088	686	480	836	1851	1261
HMN	1594	758	1374	659	644	827	1469	1231	1935	1786	1786	2053	1333	815	1137	1820	1373
HST	99	2391	2764	2291	2271	1398	1320	453	1374	1030	1030	1343	2745	1821	1795	1264	1494
IAB	1292	1245	1468	1169	1177	269	867	845	1331	1200	1200	1452	1449	557	704	1217	794
IND	1077	1846	1881	1775	1786	507	366	650	744	590	590	849	1877	925	788	621	471
INH	997	2339	2341	2266	2274	1000	522	741	463	137	137	473	2343	1403	1199	347	753
KBY	424	2199	2464	2107	2097	1075	957	237	1057	722	722	1054	2451	1507	1447	937	1129
LFI	929	2394	2425	2318	2323	1070	619	713	529	185	185	512	2425	1480	1288	423	848
LGB	2293	68	1039	43	92	1342	2000	1930	2489	2402	2402	2628	984	1091	1458	2389	1843
LIC	1715	2791	2510	2729	2763	1437	776	1487	316	614	614	283	2529	1717	1389	445	935
LRF	952	1533	1811	1447	1444	488	819	501	1206	997	997	1296	1792	879	937	1079	844
LSV	2149	270	910	235	283	1101	1753	1759	2244	2171	2171	2386	860	835	1202	2147	1591
LUF	1955	396	1151	298	290	1059	1720	1590	2204	2092	2092	2335	1103	891	1255	2097	1586
MCC	2515	322	676	409	473	1370	1991	2113	2481	2450	2450	2635	620	1019	1359	2396	1802
MCF	226	2213	2564	2116	2099	1199	1158	254	1267	930	930	1259	2547	1621	1601	1148	1316
MEM	885	1671	1899	1586	1585	527	721	423	1077	855	855	1160	1884	949	951	949	781
MIB	1971	1342	970	1325	1370	568	898	1510	1349	1422	1422	1514	980	300	189	1293	669
MTC	1245	2046	1954	1984	2002	677	137	865	483	432	432	610	1959	1038	803	372	354
MTO	2320	647	485	675	737	1030	1603	1883	2085	2090	2090	2243	447	627	938	2010	1399
NCO	1208	2627	2505	2562	2577	1261	643	1107	239	235	235	127	2515	1617	1347	243	866
NFL	2383	361	643	413	479	1211	1831	1972	2320	2290	2290	2472	590	859	1202	2235	1642
NGU	899	2401	2445	2324	2328	1084	647	694	561	216	216	538	2445	1498	1312	456	876
NGW	2552	290	738	389	449	1436	2062	2157	2552	2516	2516	2703	681	1093	1436	2466	1875
NHE	1001	2382	2382	2309	2317	1043	555	764	456	116	116	451	2384	1445	1238	347	788
NIF	400	2206	2480	2112	2103	1092	980	236	1078	742	742	1074	2466	1524	1467	959	1152
NJO	1094	2054	2040	1985	1997	701	296	712	547	381	381	641	2041	1029	907	420	434
NJT	742	2406	2409	2324	2324	1127	760	600	761	356	356	670	2505	1552	1395	547	989
NLA	2398	146	841	228	233	1334	1977	2012	2468	2411	2411	2615	785	1026	1344	2376	1802
NLA	539	1874	2223	1779	1765	883	994	110	1237	940	940	1276	2204	1291	1311	1164	1144
NMA	0	2371	2760	2250	2227	1412	1379	462	1457	1114	1114	1432	2740	1828	1822	1344	1591
NTO	2371	0	988	108	160	1369	2023	1982	2513	2435	2435	2655	932	1098	1463	2415	1869
NUW	2766	988	0	1354	1121	1397	1867	2311	2315	2386	2386	2481	57	962	1159	2263	1639
NZJ	2250	104	1074	0	67	1309	1967	1888	2456	2365	2365	2594	999	1067	1435	2355	1811
NZY	2227	160	1121	67	0	1329	1989	1875	2477	2376	2376	2612	1068	1105	1474	2373	1841
OFF	1412	1369	1397	1309	1329	0	662	951	1148	1080	1080	1286	1388	435	456	1047	546
OSC	1379	2023	1867	1967	1989	662	0	989	491	530	530	641	1875	978	708	406	236

	NQX	NTD	NUW	NZJ	NZY	OFF	OSC	PAM	PBG	PHL	PNE	PSM	PWT	RCA	RDR	RME	SAW
PAM	462	1982	2311	1888	1875	951	989	0	1189	877	877	1214	2293	1369	1364	1062	1120
PBG	1457	2513	2315	2456	2477	1148	491	1189	0	345	345	167	2329	1464	1165	130	688
PHL	1114	2435	2386	2365	2376	1080	530	877	345	0	0	337	2391	1465	1232	246	765
PNE	1114	2435	2386	2365	2376	1080	530	877	345	0	0	337	2391	1465	1232	246	765
PSM	1432	2655	2481	2594	2612	1286	641	1214	167	337	337	0	2494	1619	1328	239	849
PWT	2740	932	57	999	1066	1388	1875	2293	2329	2391	2391	2494	0	955	1168	2273	1649
RCA	1828	1098	962	1067	1105	435	978	1369	1464	1465	1465	1619	955	0	369	1385	783
RDR	1822	1463	1159	1435	1474	456	708	1364	1165	1232	1232	1328	1168	369	0	1105	481
RME	1344	2415	2263	2355	2373	1047	406	1062	130	246	246	239	2273	1385	1105	0	625
SAW	1543	1860	1639	1813	1841	546	236	1120	688	765	765	849	1649	783	481	625	0
SBD	2241	110	1010	51	113	1272	1929	1872	2419	2333	2333	2558	956	1021	1389	2319	1772
SKA	2527	922	237	967	1032	1159	1643	2076	2100	2158	2158	2265	233	725	937	2043	1418
SKF	1095	1260	1824	1157	1132	832	1328	781	1724	1499	1499	1809	1790	1057	1267	1596	1316
SSC	641	2210	2378	2125	2122	982	754	385	834	504	504	840	2370	1416	1306	713	945
SCU	2529	314	692	405	468	1392	2014	2129	2503	2471	2471	2655	635	1042	1383	2418	1825
SZL	1197	1459	1593	1386	1396	216	659	736	1112	980	980	1231	1580	637	660	997	619
TCM	2729	913	75	980	1047	1381	1872	2283	2328	2388	2388	2493	19	948	1167	2272	1647
TIK	1207	1240	1561	1155	1155	412	966	777	1410	1247	1247	1521	1537	684	850	1291	918
TWH	894	2402	2448	2324	2329	1086	652	691	566	221	221	543	2448	1501	1316	462	880
VAD	443	2099	2383	2007	1996	1002	945	138	1093	768	768	1105	2369	1430	1390	969	1101
VPS	509	1922	2257	1828	1815	905	979	60	1204	901	901	1237	2238	1319	1326	1076	1100
WRB	567	2055	2292	1966	1959	901	820	200	990	678	678	1014	2279	1334	1276	863	976
WRI	1156	2471	2404	2402	2414	1111	541	926	307	49	49	289	2410	1490	1248	221	776

	SBD	SKA	SKF	SSC	SUU	SZL	TCM	TIK	TWH	VAD	VPS	WRB	WRI
ABQ	616	1024	615	1486	868	757	1170	515	1686	1379	1207	1330	1775
AEX	1452	1729	384	721	1719	503	1923	397	993	547	362	533	1174
BAD	1373	1630	362	764	1631	424	1825	299	1021	616	440	586	1184
BIX	1685	1930	591	536	1950	627	2131	610	832	324	133	340	1044
BYH	1560	1639	673	545	1766	286	1854	431	749	508	411	419	883
CBM	1652	1793	659	460	1882	449	2003	526	716	358	243	293	894
CHS	2132	2197	1108	73	2350	850	2418	1002	349	227	402	194	604
COF	2199	2383	1090	375	2457	1030	2595	1103	625	236	388	343	888
CVS	796	1168	447	1310	1056	620	1329	345	1523	1194	1020	1149	1628
DAG	2236	2113	1367	367	2391	881	2342	1133	127	629	760	536	190
DCA	2236	2104	1376	386	2388	881	2333	1137	146	648	776	553	175
DLH	1562	1187	1238	1086	1597	560	1417	820	1071	1199	1161	1079	995
DMA	405	1114	749	1750	749	1061	1205	793	1971	1614	1431	1582	2075
DOV	2325	2164	1476	470	2468	971	2394	1232	185	735	871	646	81
DYS	1025	1403	219	1116	1305	551	1574	245	1357	971	789	941	1495
FEW	842	769	888	1421	926	620	970	564	1550	1394	1259	1311	1576
FFO	1857	1742	1078	458	2005	504	1970	780	474	617	648	492	515
FWH	1150	1473	232	984	1412	468	1654	193	1228	841	661	810	1372
GFA	966	294	1421	1858	822	1083	524	1096	1923	1877	1762	1780	1884
GON	2483	2246	1687	692	2601	1140	2475	1419	393	957	1095	870	145
GDB	2232	2199	1278	190	2420	897	2425	1106	119	452	610	384	376
GUS	1751	1617	1035	568	1888	409	1845	702	599	697	697	573	619
HIF	572	520	1104	1783	567	983	672	875	1917	1739	1591	1663	1939
HMN	648	1185	509	1589	954	823	1317	540	1714	1353	1171	1320	1828
HST	2281	2529	1143	572	2558	1186	2735	1221	809	405	507	524	1071
IAB	1140	1235	566	982	1328	221	1439	146	1156	929	789	853	1238
IND	1743	1646	987	519	1894	391	1872	672	579	634	631	511	628
INH	2235	2109	1369	373	2390	881	2338	1134	133	635	765	541	186
KBY	2089	2227	1017	224	2330	872	2442	973	512	102	293	174	768
LFI	2289	2192	1383	331	2455	937	2420	1175	39	596	743	517	228
LEB	71	961	1200	2166	377	1423	965	1195	2363	2049	1870	2007	2439
LIC	2700	2307	2040	1118	2759	1419	2531	1720	826	1382	1507	1287	567
LRF	1425	1576	519	678	1649	277	1782	295	902	589	446	525	1042
LSV	197	784	1077	1964	386	1198	842	997	2145	1869	1698	1816	2206
LUF	286	1006	865	1832	620	1112	1085	865	2040	1709	1530	1670	2130
MAT	376	649	1451	2292	24	1503	601	1240	2447	2217	2053	2156	2480
MIF	2103	2329	980	436	2371	986	2537	1027	716	217	309	342	971
MIM	1562	1662	649	540	1775	313	1875	431	757	485	378	402	901
MIB	1277	751	1321	1479	1242	783	979	920	1502	1546	1467	1436	1437
MFO	1948	1726	1294	618	2079	929	1956	930	526	814	859	690	453
MID	625	313	1345	1999	461	1199	432	1113	2115	1969	1826	1889	2116
MIO	2028	2294	1731	727	2654	1185	2513	1464	425	992	1133	908	127
NEL	268	561	1136	2140	183	1348	571	1196	2290	2073	1913	2008	2320
NOM	2295	2212	1377	319	2466	946	2440	1178	6	574	726	500	257
NOX	265	724	1479	2346	57	1562	663	1388	2508	2264	2097	2206	2547
NOY	2278	2150	1406	389	2433	924	2380	1175	116	653	790	565	163
NIP	2096	2243	1017	246	2340	808	2457	983	531	107	294	193	788
NIS	1953	1908	1177	459	2092	602	2036	882	409	655	711	532	417
NIT	2299	2274	1456	224	2479	968	2160	1170	136	478	640	419	396
NIV	199	762	1318	2219	177	1444	767	1251	2491	2121	1941	2073	2444
NPA	1764	1979	672	667	2024	667	2104	678	768	244	52	271	986
NPR	2241	2527	1047	641	2529	1137	2729	1207	894	443	509	567	1126
NPS	119	322	1260	2219	314	1479	913	1240	2402	2099	1922	2055	2471
NRW	1015	237	1424	2371	642	1543	75	1561	2448	2383	2157	2292	2484
NSE	51	967	1157	2125	435	1366	940	1155	2124	2007	1828	1966	2402
NYS	113	1032	1132	2122	468	1396	1947	1155	2329	1996	1815	1959	2414
OFF	1272	1159	832	982	1392	216	1381	412	1086	1002	905	901	1111
OKC	1929	1643	1328	754	2014	659	1872	966	652	945	979	820	541

	SBD	SKA	SKF	SSC	SUU	SZL	TCM	TIK	TWH	VAD	VPS	WRB	WRI
PAM	1872	2076	781	385	2129	736	2283	777	691	138	60	200	926
PBG	2419	2100	1724	834	2503	1112	2328	1410	566	1093	1204	990	307
PHL	2333	2158	1499	504	2471	980	2388	1247	221	768	901	678	49
PNE	2333	2158	1499	504	2471	980	2388	1247	221	768	901	678	49
PCM	2558	2265	1809	840	2655	1231	2493	1521	543	1105	1237	1014	289
PWT	956	233	1790	2370	635	1580	19	1537	2448	2369	2238	2279	2410
RCA	1021	725	1057	1416	1042	637	948	684	1501	1430	1319	1334	1490
RDR	1389	937	1267	1306	1383	660	1167	850	1316	1390	1326	1276	1248
RME	2319	2043	1596	713	2418	997	2272	1291	462	969	1076	863	221
SAW	1772	1418	1316	945	1825	619	1647	918	880	1101	1100	976	776
SBD	0	918	1151	2102	375	1355	937	1131	2296	1989	1812	1945	2369
SKA	918	0	1613	2141	669	1356	230	1331	2215	2147	2022	2055	2177
SKF	1151	1613	0	1104	1463	697	1776	420	1375	915	724	914	1545
SSC	2102	2141	1104	0	2311	801	2363	970	306	265	420	196	551
SUU	375	669	1463	2311	0	1523	617	1357	2468	2234	2069	2173	2502
SZL	1355	1356	697	801	1523	0	1572	308	947	793	689	699	1018
TCM	937	230	1776	2363	617	1572	0	1526	2443	2359	2228	2271	2407
TIK	1131	1331	420	970	1357	308	1526	0	1178	877	719	819	1289
TWH	2296	2215	1375	306	2468	947	2443	1178	0	570	723	497	262
VAD	1989	2147	915	265	2234	793	2359	877	570	0	191	125	816
VPS	1812	2022	724	420	2069	689	2228	719	723	191	0	227	950
WRB	1945	2055	914	196	2173	699	2271	819	497	125	227	0	726
WRI	2369	2177	1545	551	2502	1018	2407	1289	262	816	950	726	0

Combined System Inter-locational surface statute mileage

LOC	ABQ	AEX	BAD	BIX	BYH	CBM	CHS	COP	CVS	DAG	DCA	DLH	DMA	DOV	DYS	FEW	FFO
ABQ	0	1022	920	1301	1134	1244	1819	1914	226	1959	1960	1301	376	2071	525	516	1513
AEX	1022	0	118	280	410	337	872	897	797	1190	1202	1267	1283	1323	513	1153	885
BAD	920	118	0	383	378	368	935	994	696	1208	1218	1179	1199	1338	428	1034	865
BIX	1301	280	383	0	447	261	632	617	1076	1026	1043	1365	1562	1160	793	1395	824
BYH	1134	410	378	447	0	202	701	893	931	858	865	918	1467	983	736	1071	487
CBM	1244	337	368	261	202	0	577	711	1028	853	865	1112	1551	986	787	1243	578
CHS	1819	872	935	632	701	577	0	365	1605	510	534	1387	2128	628	1361	1764	635
COP	1914	897	994	617	893	711	365	0	1690	864	889	1701	2178	971	1410	1954	973
CVS	226	797	696	1076	931	1028	1605	1690	0	1772	1775	1231	538	1889	303	574	1339
DAG	1959	1190	1208	1026	858	853	510	864	1772	0	26	1147	2310	135	1594	1762	464
DCA	1960	1202	1218	1043	865	865	534	889	1775	26	0	1132	2313	121	1601	1756	459
DLH	1301	1267	1179	1365	918	1112	1387	1701	1231	1147	1132	0	1670	1189	1270	865	758
DMA	376	1283	1199	1562	1467	1551	2128	2178	538	2310	2313	1670	0	2427	772	844	1874
DOV	2071	1323	1338	1160	983	986	628	971	1889	135	121	1189	2427	0	1719	1851	562
DYS	525	513	428	793	736	787	1361	1410	303	1594	1601	1270	772	1719	0	803	1197
FEW	516	1153	1034	1395	1071	1243	1764	1954	574	1762	1756	865	844	1851	803	0	1298
FFO	1513	885	865	824	487	578	635	973	1339	464	459	758	1874	562	1197	1298	0
FWH	661	362	270	642	587	629	1203	1258	435	1443	1451	1208	929	1570	158	860	1059
GFA	1058	1787	1669	2014	1643	1833	2299	2536	1189	2184	2173	1074	1259	2245	1445	646	1742
GON	2276	1581	1590	1428	1225	1245	889	1219	2106	402	385	1270	2640	269	1956	2011	767
GSE	1943	1073	1114	866	809	746	277	616	1740	251	277	1301	2275	355	1527	1813	553
GUS	1397	868	828	856	458	597	765	1087	1234	608	601	622	1763	696	1118	1156	151
HIP	606	1520	1405	1782	1496	1657	2194	2364	789	2201	2196	1243	747	2289	1083	441	1738
HMN	209	971	885	1250	1158	1237	1813	1867	244	2007	2011	1457	315	2126	458	717	1580
HST	2029	1008	1117	735	1081	886	600	236	1803	1092	1118	1923	2264	1193	1510	2119	1205
IAB	644	608	491	835	526	684	1228	1394	481	1316	1317	817	1008	1427	453	563	869
IND	1378	798	764	777	390	519	703	1016	1206	597	594	687	1739	698	1074	1166	136
INH	1959	1193	1210	1031	859	856	518	872	1772	8	17	1142	2311	130	1595	1759	462
KBY	1773	779	861	511	707	539	196	208	1552	705	729	1494	2059	824	1287	1776	767
LFI	2017	1204	1232	1018	898	869	454	792	1824	109	131	1251	2362	179	1631	1841	546
LGB	816	1811	1719	2091	1950	2057	2633	2708	1029	2765	2765	1959	541	2872	1298	1095	2311
LIE	2584	2028	2019	1908	1641	1700	1405	1739	2443	903	881	1394	2958	778	2341	2234	1122
LRF	970	278	207	434	191	279	849	984	759	1047	1055	989	1290	1174	547	975	671
LSV	590	1612	1511	1891	1704	1828	2398	2504	815	2495	2493	1654	454	2597	1109	792	2036
LTF	426	1402	1311	1682	1555	1653	2230	2299	627	2385	2386	1672	156	2497	899	819	1949
MCO	1025	2014	1949	2321	2097	2238	2798	2928	1250	2844	2840	1889	891	2936	1549	1086	2381
MCT	1807	785	889	506	841	646	448	152	1581	958	982	1697	2057	1074	1294	1980	999
MEM	1136	370	346	402	46	163	690	865	928	874	882	963	1462	1002	721	1093	523
MIB	1140	1518	1408	1692	1268	1469	1853	2133	1167	1669	1655	530	1459	1717	1329	625	1251
MTG	1651	1129	1098	1080	722	832	829	1186	1498	488	471	663	2021	528	1394	1361	276
MUO	886	1808	1692	2067	1765	1933	2458	2643	1078	2430	2423	1400	962	2509	1374	695	1979
NCO	2330	1633	1643	1476	1278	1296	929	1252	2160	450	434	1316	2694	316	2010	2064	822
NFL	873	1892	1773	2156	1916	2062	2618	2759	1095	2654	2649	1697	798	2745	1397	894	2130
NFM	2023	1194	1226	1091	899	861	424	757	1827	146	169	1281	2365	216	1629	1857	566
NOE	1071	2093	1990	2371	2161	2297	2861	2982	1297	2920	2916	1978	905	3014	1592	1165	2457
NHE	2010	1235	1255	1066	907	898	531	878	1823	51	56	1187	2361	98	1643	1511	513
NIP	1783	783	868	512	725	553	221	182	1561	731	755	1520	2065	849	1293	1792	794
NFO	1632	997	982	916	605	680	638	994	1460	368	359	799	1994	451	1319	1430	123
NFT	2021	1131	1173	911	887	911	242	595	1816	305	390	1388	2149	385	1596	1899	642
NIG	1644	1614	1414	2134	2006	2122	2792	2808	1118	2747	2787	1897	764	2886	1408	1054	214
NIA	1892	1771	1721	1474	1274	1274	542	523	1168	959	977	1085	1658	1093	988	1463	146
NIR	1693	899	1740	718	1094	899	686	324	1763	1188	1214	1967	2212	1294	1479	2112	1248
NIS	873	1674	1746	2174	2432	2114	2689	2771	1087	2808	2807	1975	614	2913	1362	1113	213
NLA	1467	2450	2232	2196	2252	2435	2921	3143	1653	2814	2802	1693	1721	2877	1942	1203	2071
NLI	144	1760	1668	2040	1902	2098	2584	2657	980	2720	2720	1926	490	2828	1247	1061	2267
NLY	771	1743	1656	2023	1903	2001	2578	2639	975	2729	2730	1965	462	2839	1231	1099	2260
OFF	894	845	740	1011	598	796	1246	1485	755	1202	1197	494	1239	1292	776	560	739
OPR	1653	1233	1189	1212	824	957	993	1349	1519	634	614	548	2028	653	1447	1318	399

LOC	ABQ	AEX	BAD	BIX	BYH	CRM	CHS	COF	CVS	DAG	DCA	DLH	DMA	DOV	DYS	PEW	PFO
PAM	1520	506	600	230	545	345	430	394	1296	883	904	1431	1790	1014	1019	1576	788
PBG	2227	1650	1638	1538	1261	1324	1073	1425	2078	563	539	1105	2600	457	1965	1908	776
PHL	2084	1352	1365	1195	1006	1015	670	1013	1905	170	152	1177	2442	43	1741	1854	572
PNE	2084	1352	1365	1195	1006	1015	670	1013	1905	170	152	1177	2442	43	1741	1854	572
PSM	2381	1735	1737	1594	1365	1401	1068	1399	2221	574	554	1298	2750	444	2088	2084	891
PWT	1422	2321	2204	2571	2235	2415	2910	3125	1612	2815	2804	1703	1467	2877	1905	1176	2370
RCA	780	1276	1159	1489	1108	1299	1767	2000	816	1687	1678	668	1105	1761	1007	265	1232
RDR	1182	1391	1287	1537	1099	1301	1648	1942	1165	1444	1430	303	1530	1491	1277	688	1035
RME	2096	1494	1485	1382	1108	1168	931	1288	1940	424	399	1027	2466	336	1818	1797	624
SAW	1511	1285	1217	1324	892	1064	1221	1562	1410	910	892	280	1886	935	1395	1117	589
SBD	739	1742	1648	2022	1872	1982	2558	2639	955	2683	2683	1874	486	2790	1230	1010	2228
SKA	1229	2074	1957	2317	1967	2152	2637	2860	1401	2536	2524	1425	1336	2597	1683	922	2091
SKF	738	461	434	709	808	791	1329	1309	536	1640	1651	1486	899	1772	263	1066	1293
SSC	1783	865	917	643	654	552	88	450	1572	440	463	1303	2101	564	1339	1705	549
SUU	1042	2062	1957	2340	2119	2258	2820	2948	1268	2869	2865	1917	899	2962	1566	1111	2406
SZL	909	603	508	752	343	538	1020	1236	744	1058	1057	671	1273	1165	661	744	605
TCM	1404	2307	2190	2558	2224	2404	2901	3114	1595	2810	2799	1700	1446	2873	1889	1164	2364
TIK	618	477	359	732	517	632	1202	1324	414	1360	1364	985	952	1479	294	676	936
TWH	2023	1192	1225	998	899	859	419	750	1827	152	176	1285	2365	222	1628	1860	569
VAD	1655	656	740	389	609	430	272	284	1433	755	778	1439	1937	882	1165	1672	740
VPS	1448	434	528	160	493	291	482	466	1224	912	931	1393	1718	1045	947	1510	777
WRB	1596	639	703	408	502	352	233	411	1379	644	664	1294	1899	775	1130	1573	590
WRI	2131	1409	1421	1253	1060	1073	725	1065	1954	228	210	1195	2490	97	1794	1891	617

LOC	FWH	GPA	GON	GSB	GUS	HIP	HMN	HST	IAB	IND	INH	KBY	LFI	LGB	LIZ	LRF	LSV
ABQ	661	1058	2276	1943	1397	606	209	2029	644	1378	1959	1773	2017	816	2584	970	590
AEX	362	1787	1581	1073	868	1520	971	1008	608	798	1193	779	1204	1811	2028	278	1612
BAD	270	1669	1590	1114	828	1405	885	1117	491	764	1210	861	1232	1719	2018	207	1511
BIX	642	2014	1428	866	856	1782	1250	735	835	777	1031	511	1018	2091	1908	434	1891
BYH	587	1643	1225	809	458	1496	1158	1081	526	390	859	707	898	1950	1641	191	1704
CHM	629	1833	1245	746	597	1657	1237	886	684	519	856	539	869	2057	1700	279	1828
CHS	1203	2299	889	277	765	2194	1813	600	1228	703	518	196	454	2633	1405	849	2398
COF	1258	2536	1219	616	1087	2364	1867	236	1394	1016	872	208	792	2708	1739	984	2504
CVS	435	1189	2106	1740	1234	789	244	1803	481	1206	1772	1552	1824	1029	2443	759	815
DAG	1443	2184	402	251	608	2201	2007	1092	1316	597	8	705	109	2765	903	1047	2495
DCA	1451	2173	385	277	601	2196	2011	1118	1317	594	17	729	131	2765	881	1055	2493
DLH	1208	1074	1270	1301	622	1243	1457	1923	817	687	1142	1494	1251	1959	1394	989	1654
DMA	929	1259	2640	2275	1763	747	315	2264	1008	1739	2311	2059	2362	541	2958	1290	454
DOV	1570	2245	269	355	696	2289	2126	1193	1427	698	130	824	179	2872	778	1174	2597
DYS	158	1445	1956	1527	1118	1083	458	1510	453	1074	1595	1287	1631	1298	2341	547	1109
FEW	860	646	2011	1813	1156	441	717	2119	563	1166	1759	1776	1841	1095	2234	975	792
FEO	1059	1742	767	553	151	1738	1580	1205	869	136	462	767	546	2311	1155	671	2036
FWH	0	1506	1811	1370	991	1185	614	1368	407	940	1445	1131	1477	1451	2210	397	1250
GPA	1506	0	2344	2292	1591	516	1265	2719	1182	1628	2180	2344	2280	1228	2432	1583	955
GON	1811	2344	0	613	880	2442	2347	1432	1633	901	397	1085	435	3064	520	1416	2779
GSB	1370	2292	613	0	703	2252	1964	842	1317	664	259	473	178	2758	1130	986	2504
GUS	991	1591	980	703	0	1595	1477	1314	755	80	605	879	694	2185	1223	624	1905
HIP	1185	516	2442	2252	1595	0	798	2515	973	1606	2199	2195	2282	765	2635	1381	466
HMN	614	1265	2347	1964	1477	798	0	1960	725	1447	2008	1745	2055	842	2687	978	682
HST	1368	2719	1432	842	1314	2515	1960	0	1556	1241	1100	438	1014	2801	1951	1144	2619
IAB	407	1182	1633	1317	755	973	725	1556	0	733	1316	1222	1378	1449	1962	412	1187
IND	940	1628	901	664	80	1606	1447	1241	733	0	596	808	675	2175	1269	563	1909
INH	1445	2180	397	259	605	2199	2008	1100	1316	596	0	713	116	2764	896	1049	2494
KBY	1131	2344	1085	473	879	2195	1745	438	1222	808	713	0	650	2579	1602	818	2561
LFI	1477	2280	435	178	694	2282	2055	1014	1378	675	116	650	0	2827	952	1084	2562
LGB	1451	1228	3064	2758	2185	765	842	2801	1449	2175	2764	2579	2827	0	3325	1786	308
LIZ	2210	2432	520	1130	1223	2635	2687	1951	1962	1269	896	1602	952	3325	0	1826	3026
LRF	397	1583	1416	986	624	1381	978	1144	412	563	1049	818	1084	1786	1826	0	1551
LSV	1250	955	2779	2504	1905	466	682	2618	1187	1900	2494	2361	2562	308	3026	1551	0
LUF	1042	1160	2700	2364	1820	644	434	2394	1070	1803	2385	2172	2442	409	2995	1385	301
MOC	1685	958	2095	2840	2250	653	1132	3052	1571	2247	2842	2776	2921	459	3283	1958	459
MPI	1147	2479	1331	719	1097	2280	1748	240	1317	1022	965	255	897	2590	1849	905	2397
MEM	569	1673	1248	813	499	1513	1151	1047	541	429	876	683	910	1952	1671	175	1717
MIB	1330	556	1798	1804	1104	850	1338	2339	933	1155	1664	1931	1770	1613	1877	1266	1309
MIS	1267	1719	651	672	276	1792	1742	1422	1017	334	482	986	594	2422	949	896	2174
MUS	1476	437	2643	2499	1823	291	1067	2799	1249	1843	2427	2468	2516	811	2791	1660	571
NCO	1865	2390	54	652	935	2493	2402	1462	1687	955	445	1124	476	3117	490	1469	2833
NEL	1526	798	2902	2693	2049	460	1002	2990	1390	2057	2652	2601	2732	483	3091	1783	344
NGU	1475	2304	467	147	715	2298	2057	977	1387	692	154	620	40	2835	985	1083	2572
NOE	1732	1055	3176	2950	2318	739	1163	3100	1637	2323	2918	2833	2995	428	3372	2018	444
NRK	1492	2229	366	261	656	2251	2058	1102	1367	648	52	727	93	2816	875	1096	2545
NIP	1137	2364	1109	496	906	2210	1751	411	1237	834	739	28	674	2587	1626	832	2371
NKO	1181	1818	846	504	245	1849	1701	1229	988	255	364	794	462	2426	1046	791	2148
NMT	1438	2381	625	89	792	2338	2037	810	1399	754	313	478	209	2837	1144	1059	2557
NOR	1553	1059	3060	2903	2191	658	971	2919	1487	2190	2786	2665	2857	244	3284	1454	144
NPA	736	2079	1361	736	836	1362	1356	652	906	767	964	414	944	2186	1951	466	144
NPS	1334	2724	1538	940	1368	2498	1913	119	1550	1293	1196	508	1115	2792	2058	1142	2574
PTD	1513	1207	3049	2807	2222	760	969	2869	1494	2215	2807	2639	2873	82	3349	1840	327
PTW	2044	631	2962	2922	2222	760	1648	3316	1762	2258	2819	2957	2910	1247	3012	2173	1042
PTZ	1590	1229	7621	2710	2141	745	791	2750	1403	2130	2719	2529	2781	52	3297	1737	241
RAY	1386	1289	3018	2712	2158	805	772	2726	1413	2144	2729	2517	2788	111	3316	1733	340
REK	722	1055	1460	1264	596	999	993	1678	323	608	1200	1290	1284	1611	1725	585	1321
REN	1442	1620	724	842	366	1736	1763	1585	1040	439	627	1148	742	2400	931	983	2184

LOC	FWH	GPA	GON	GSB	GUS	HIF	HMN	HST	IAB	IND	INH	KBY	LPI	LGB	LIZ	LRP	LSV
PAM	866	2176	1283	690	858	1978	1477	544	1014	779	889	285	856	2316	1784	601	2110
PBG	1832	2174	273	808	849	2324	2322	1649	1597	892	555	1268	635	2987	379	1447	2693
PHL	1593	2237	233	398	702	2291	2144	1236	1440	708	164	866	222	2883	737	1197	2606
PNF	1593	2237	233	398	702	2291	2144	1236	1440	708	164	866	222	2883	737	1197	2606
PSM	1948	2370	180	792	987	2506	2464	1611	1742	1019	568	1265	614	3154	340	1555	2864
PWT	2001	632	2972	2917	2220	823	1600	3295	1739	2253	2811	2941	2910	1180	3035	2151	1032
RCA	1033	536	1891	1774	1082	576	978	2185	668	1110	1683	1809	1776	1309	2061	1055	1002
RDR	1251	776	1571	1586	890	1003	1364	2154	845	945	1439	1736	1546	1750	1667	1124	1442
RME	1683	2101	252	674	707	2221	2183	1516	1460	745	416	1124	508	2867	534	1295	2576
SAW	1305	1352	995	1093	487	1513	1647	1793	953	565	904	1355	1018	2212	1123	1012	1909
SBD	1381	1159	2980	2679	2101	686	777	2737	1368	2092	2682	2507	2746	85	3240	1709	224
SKA	1767	352	2695	2639	1940	624	1422	3034	1482	1975	2531	2673	2630	1154	2769	1891	941
SKF	278	1706	2024	1533	1242	1325	611	1371	679	1184	1643	1220	1660	1440	2448	622	1292
SSC	1181	2229	830	228	682	2139	1787	686	1179	622	447	268	397	2599	1341	814	2357
STU	1703	986	3121	2903	2266	680	1145	3070	1594	2272	2867	2796	2946	452	3311	1979	463
SZL	561	1300	1368	1076	490	1180	988	1423	265	469	1057	1046	1125	1708	1703	332	1438
TCM	1985	628	2970	2910	2213	806	1581	3282	1727	2246	2806	2931	2905	1158	3037	2139	1019
TIK	231	1316	1702	1327	843	1050	648	1465	176	806	1360	1168	1410	1434	2065	354	1197
TWH	1474	2307	472	142	719	2300	2057	971	1388	695	160	614	46	2836	991	1083	2574
VAD	1009	2252	1149	543	836	2087	1623	486	1114	761	762	123	715	2459	1658	707	2243
VPS	794	2115	1314	731	836	1910	1405	608	947	757	918	352	892	2244	1808	536	2038
WRB	972	2136	1044	460	688	1996	1584	629	1024	613	650	209	620	2409	1544	630	2180
WRI	1647	2260	174	451	743	2326	2193	1285	1486	753	223	921	273	2926	681	1250	2647

LOC	LUF	MCC	MCF	MEM	MIB	MTC	MUO	NCO	NPL	NGU	NGZ	NHK	NIP	NKO	NKT	NLC	NPA
ABQ	426	1025	1807	1136	1140	1651	886	2330	873	2023	1071	2010	1783	1632	2021	894	1392
APX	1402	2044	785	370	1518	1129	1808	1633	1882	1194	2093	1235	783	997	1131	1914	375
BAD	1311	1939	889	346	1408	1098	1692	1643	1773	1226	1990	1255	868	982	1178	1814	472
BIK	1682	2321	506	402	1692	1080	2067	1476	2156	1001	2371	1066	512	916	911	2194	97
BYH	1555	2077	841	46	1268	722	1765	1278	1916	899	2161	907	725	605	887	2006	474
CBM	1653	2238	646	163	1469	832	1933	1296	2062	861	2297	898	553	680	811	2132	274
CHS	2230	2798	443	690	1853	829	2458	929	2618	424	2861	531	221	638	292	2702	542
COP	2299	2928	152	865	2133	1186	2643	1252	2759	757	2982	878	182	994	595	2808	523
CVS	627	1250	1581	928	1167	1498	1078	2160	1095	1827	1297	1823	1561	1460	1816	1118	1168
DAG	2385	2844	958	874	1669	488	2430	450	2654	146	2920	51	731	368	305	2787	959
DCA	2386	2840	982	882	1655	471	2423	434	2649	169	2916	56	755	359	330	2785	977
DLH	1672	1889	1697	963	530	663	1400	1316	1697	1281	1978	1187	1520	799	1388	1897	1385
DMA	156	891	2057	1462	1459	2021	962	2694	798	2365	905	2361	2065	1994	2349	704	1658
DOV	2497	2936	1074	1002	1717	528	2509	316	2745	216	3014	98	849	451	385	2886	1093
DYS	889	1549	1294	721	1329	1394	1374	2010	1397	1629	1592	1643	1293	1319	1596	1408	888
FEW	819	1086	1880	1093	625	1361	695	2064	894	1857	1165	1811	1792	1400	1899	1054	1468
FFO	1939	2381	999	520	1251	256	1970	822	2190	566	2457	513	794	123	642	2326	792
FWH	1042	1685	1147	569	1330	1267	1476	1865	1526	1475	1732	1492	1137	1181	1438	1553	736
GFA	1160	958	2479	1673	556	1719	437	2390	798	2304	1055	2229	2364	1818	2381	1059	2079
GON	2700	3095	1331	1248	1798	651	2643	54	2902	467	3176	366	1109	646	625	3060	1361
GSB	2364	2880	719	813	1804	672	2499	652	2693	147	2950	261	496	504	89	2803	786
GUS	1820	2240	1097	499	1104	276	1823	935	2049	715	2318	656	906	245	792	2191	846
HIP	644	653	2280	1514	850	1792	291	2493	460	2298	739	2251	2210	1839	2338	658	1862
HMN	434	1132	1748	1151	1338	1742	1067	2402	1002	2057	1163	2058	1751	1701	2037	971	1346
HST	2394	3052	240	1047	2339	1422	2799	1462	2890	977	3100	1102	411	1229	810	2919	652
IAB	1070	1571	1317	541	933	1017	1249	1687	1390	1387	1637	1367	1237	988	1399	1487	906
IND	1803	2247	1022	429	1155	334	1843	955	2057	692	2323	648	834	255	754	2190	767
INH	2385	2842	965	876	1664	482	2427	445	2652	154	2918	52	739	364	313	2786	964
KBY	2172	2776	255	683	1931	986	2468	1124	2601	620	2833	727	28	794	478	2665	414
LFI	2442	2921	897	910	1770	594	2516	476	2732	40	2995	93	674	462	209	2857	944
LGB	409	459	2590	1952	1613	2422	811	3117	483	2835	428	2816	2587	2426	2837	244	2186
LJZ	2995	3283	1849	1671	1877	949	2791	490	3091	985	3372	875	1626	1036	1144	3284	1851
LRP	1385	1958	905	175	1266	896	1660	1469	1783	1083	2018	1096	832	791	1059	1854	496
LTV	301	450	2397	1710	1309	2134	571	2833	344	2572	484	2545	2371	2148	2585	304	1983
LUF	0	716	2182	1554	1413	2070	832	2755	645	2447	751	2436	2179	2057	2441	551	1777
MCC	736	0	2827	2109	1449	2444	525	3146	193	2935	96	2894	2788	2485	2964	216	2410
MCF	2182	2827	0	808	2103	1230	2562	1367	2661	864	2877	978	228	1037	711	2699	414
MEM	1554	2109	808	0	1306	760	1785	1301	1930	909	2171	923	700	636	888	2013	443
MIB	1413	1449	2103	1306	0	1190	932	1843	1267	1798	1544	1711	1954	1311	1893	1500	1737
MTG	2070	2444	1230	760	1190	0	1997	702	2251	627	2526	525	1014	193	754	2412	1053
MUO	822	525	2562	1785	932	1997	0	2693	361	2535	621	2478	2434	2064	2587	625	2146
NCO	2755	3146	1367	1301	1843	702	2693	0	2953	505	3228	412	1148	701	658	3113	1468
NPL	645	193	2661	1930	1267	2251	361	2953	0	2746	281	2704	2614	2294	2779	269	2243
NGU	2447	2935	864	909	1798	627	2535	505	2746	0	3008	133	643	487	170	2868	921
NGZ	751	96	2877	2171	1544	2526	621	3228	281	3008	0	2970	2844	2563	3034	202	2462
NHK	2436	2894	978	923	1711	525	2478	412	2704	133	2970	0	752	415	301	2837	997
NIP	2179	2788	228	700	1954	1014	2484	1148	2614	643	2944	752	0	822	498	2675	414
NKO	2057	2485	1037	636	1311	193	2064	701	2294	487	2563	415	822	0	590	2436	899
NKT	2441	2964	711	881	1893	754	2587	658	2779	170	3024	301	498	590	0	2885	824
NLC	551	216	2699	2014	1113	2412	625	3113	269	2868	292	2837	2675	2436	2885	0	2246
NPA	1772	2410	419	433	1732	1053	146	1508	2243	925	2462	997	414	480	826	2286	0
NGX	2346	3014	271	1062	1493	1494	2784	1570	2860	1079	3062	1201	490	1101	914	2878	644
NTD	475	387	2656	2095	1613	2455	776	3153	434	2881	319	2959	2647	2467	2887	176	2244
NUW	1382	812	3077	2279	1194	2145	581	3006	772	2934	886	2858	2976	2443	3011	1010	2694
NZB	358	490	2539	1903	1560	2381	810	3075	495	2788	466	2770	2436	2382	2789	274	2187
NZY	348	568	2519	1902	1644	2402	845	3092	575	2794	539	2780	2523	2397	2789	351	2119
OPF	1270	1645	1439	633	641	813	1236	1513	1453	1301	1723	1251	1311	841	1352	1601	1959
QSC	2064	2390	1289	865	1077	164	1924	772	2197	777	2475	666	1176	356	912	2372	1145

LOC	LUP	MCC	MCP	MEM	MIB	MTC	MUO	NCO	NFI	NGU	NGZ	NHK	NIP	NKO	NKT	NLC	NPA
PAM	1908	2535	304	508	1812	1038	2260	1328	2366	833	2588	917	283	854	720	2414	133
PBG	2644	2977	1521	1292	1619	579	2502	287	2784	673	3063	547	1294	656	842	2962	1485
PHL	2510	2940	1116	1026	1706	519	2508	282	2748	259	3019	139	891	458	428	2893	1129
PNF	2510	2940	1116	1026	1706	519	2508	282	2748	259	3019	139	891	458	428	2893	1129
PSM	2802	3159	1510	1391	1817	732	2692	152	2966	646	3244	542	1289	769	804	3137	1531
PWT	1323	743	3056	2261	1176	2351	536	3018	707	2933	817	2860	2959	2449	3006	942	2645
RCA	1069	1223	1945	1138	360	1245	752	1941	1031	1798	1311	1734	1828	1319	1863	1231	1549
RDR	1506	1631	1921	1141	227	963	1126	1616	1443	1574	1723	1486	1761	1089	1674	1661	1573
RME	2516	2875	1378	1138	1552	446	2412	292	2682	547	2959	416	1151	504	717	2851	1330
SAW	1903	2162	1581	937	803	424	1679	1040	1970	1051	2250	945	1383	593	1176	2162	1325
SBD	544	452	2523	1875	1532	2338	750	3033	441	2754	438	2734	2515	2343	2758	239	2116
SKA	1207	778	2795	1995	901	2071	376	2741	673	2654	869	2580	2692	2169	2728	939	2387
SKF	1038	1742	1176	779	1585	1517	1614	2077	1603	1652	1774	1687	1220	1412	1592	1582	806
SGC	2199	2750	523	648	1775	741	2399	872	2568	372	2815	466	296	550	269	2660	560
SUU	744	29	2846	2130	1478	2470	554	3173	220	2959	68	2919	2808	2511	2988	212	2429
STL	1334	1804	1183	376	940	755	1438	1422	1617	1135	1874	1108	1065	723	1161	1733	800
TCM	1302	721	3044	2250	1175	2347	518	3016	685	2928	796	2855	2949	2444	3090	920	2632
TIF	1038	1608	1232	517	1104	1116	1336	1757	1435	1413	1666	1410	1180	1058	1404	1501	814
TWH	2448	2937	859	908	1802	632	2538	510	2748	7	3010	139	638	491	163	2870	921
VAD	2051	2661	261	582	1855	976	2363	1191	2488	689	2717	784	128	786	564	2547	292
VPS	1836	2464	371	454	1760	1031	2192	1360	2295	872	2516	948	352	853	768	2342	63
WRB	2004	2587	410	482	1723	828	2267	1090	2410	600	2647	678	231	639	503	2484	326
WRI	2556	2976	1170	1081	1725	544	2539	224	2784	309	3056	195	946	500	475	2933	1187

LOC	NQX	NTD	NUW	NZJ	NZY	OFF	OSC	PAM	PRG	PHL	PNE	PSM	PWT	RCA	RDR	RME	SAW
ABQ	1993	870	1467	768	771	864	1653	1520	2227	2084	2084	2381	1422	780	1182	2096	1511
AEX	980	1874	2350	1760	1743	845	1233	506	1650	1352	1352	1735	2321	1276	1391	1494	1285
BAD	1093	1780	2232	1668	1656	740	1189	600	1638	1365	1365	1737	2204	1159	1287	1485	1217
BIX	718	2154	2596	2040	2023	1011	1212	230	1538	1195	1195	1594	2571	1489	1537	1382	1324
BYH	1098	2002	2252	1902	1903	598	824	545	1261	1006	1006	1365	2235	1108	1099	1108	892
CBM	899	2114	2435	2008	2001	796	957	345	1324	1015	1015	1401	2415	1299	1301	1168	1064
CHS	686	2689	2921	2584	2578	1246	993	430	1073	670	670	1068	2910	1767	1648	931	1221
COF	324	2771	3143	2657	2639	1485	1349	394	1425	1013	1013	1399	3125	2000	1942	1288	1562
CYS	1768	1087	1653	980	975	755	1519	1296	2078	1905	1905	2221	1612	816	1165	1940	1410
DAG	1188	2808	2814	2720	2729	1202	634	883	563	170	170	574	2815	1687	1444	424	910
DCA	1214	2807	2802	2720	2730	1197	614	904	539	152	152	554	2804	1678	1430	399	891
DLH	1967	1975	1693	1926	1965	494	548	1431	1105	1177	1177	1298	1703	668	303	1027	289
EMA	2212	614	1523	490	462	1239	2028	1790	2600	2442	2442	2750	1467	1105	1530	2466	1886
FOV	1294	2913	2873	2828	2839	1292	653	1014	457	43	43	444	2877	1761	1491	336	935
FYE	1470	1362	1942	1247	1231	776	1447	1019	1965	1741	1741	2088	1905	1007	1277	1818	1395
FEW	2112	1115	1200	1061	1099	560	1318	1576	1908	1854	1854	2084	1176	265	688	1797	1117
FEO	1268	2351	2322	2267	2280	739	399	788	776	572	572	891	2370	1232	1035	624	589
FWH	1334	1513	2034	1400	1386	722	1332	866	1832	1593	1593	1948	2001	1033	1251	1683	1305
GPA	2724	1293	631	1220	1289	1055	1620	2176	2174	2237	2237	2370	632	536	776	2101	1372
GN	1538	3099	2962	3021	3038	1460	724	1283	273	233	233	180	2972	1891	1571	252	845
GIB	940	2807	2922	2716	2712	1264	832	690	808	398	398	792	2917	1774	1586	674	1049
GJS	1368	2222	2222	2141	2158	596	366	858	849	702	702	987	2220	1082	890	707	487
HIF	2494	760	864	745	805	999	1736	1978	2324	2291	2291	2506	823	576	1003	2221	1512
HNN	1913	909	1648	791	772	993	1763	1477	2322	2144	2144	2464	1600	978	1364	2183	1647
HST	119	2869	3316	2750	2726	1678	1585	544	1649	1236	1236	1611	3295	2185	2154	1516	1793
IAB	1550	1494	1762	1403	1413	323	1040	1014	1597	1440	1440	1742	1739	668	845	1460	952
IND	1293	2215	2258	2120	2144	608	439	779	892	708	708	1019	2253	1110	945	745	565
INH	1196	2807	2810	2719	2729	1200	627	889	555	164	164	568	2811	1683	1439	416	904
IBY	508	2639	2957	2929	2917	1290	1148	285	1268	866	866	1265	2941	1809	1736	1124	1355
III	1115	2873	2910	2791	2758	1284	742	856	635	222	222	614	2910	1776	1546	508	1318
IGB	2752	82	1247	52	111	1611	2480	2316	2967	2883	2883	3154	1180	1309	1750	2867	2212
ILC	2058	2249	2012	2287	2316	1725	931	1784	379	737	737	340	3035	2061	1667	534	1120
IPF	1142	1940	2173	1737	1733	584	983	601	1447	1197	1197	1555	2151	1055	1124	1295	1312
ISN	2579	321	1992	291	346	1321	2104	2110	2692	2606	2606	2864	1032	1002	1442	2576	1904
ITF	2146	475	1392	338	348	1273	2064	1908	2644	2510	2510	2802	1323	1069	1506	2316	184
NYT	1613	387	812	490	564	1645	2390	2535	2977	2940	2940	3159	747	1223	1631	2875	2162
NYE	271	2656	3077	2539	2519	1439	1989	304	1521	1116	1116	1510	3056	1945	1921	1378	1181
NYM	1962	2095	2279	1903	1902	613	865	508	1292	1026	1026	1391	2261	1138	1141	1138	937
NYB	2365	1610	1164	1590	1644	681	1077	1812	1619	1796	1796	1817	1176	360	227	1552	801
NYC	1194	2455	2345	2381	2462	814	164	1038	579	519	519	732	2351	1245	963	446	424
NYD	2784	776	581	810	885	1236	1924	2260	2502	2504	2508	2692	536	752	1126	2412	1679
NYE	1573	1153	2006	3025	3042	1513	772	1328	287	282	282	152	3018	1941	1616	292	1446
NYF	2660	433	772	445	475	1453	2197	2366	2784	2744	2748	2966	707	1091	1442	2682	1977
NYG	1679	2981	2934	2798	2794	1361	777	833	673	259	259	646	2933	1738	1574	947	1071
NYH	3062	449	886	466	539	1727	2475	2588	3063	3019	3019	3244	817	1311	1723	2949	2277
NYI	1191	2959	2958	2776	2783	1251	646	917	547	139	139	542	2860	1734	1486	416	947
NYJ	2489	2647	2976	2936	2723	1411	1176	243	1294	891	891	1289	2959	1828	1761	1171	1184
NYK	1111	1667	2448	2392	2397	741	256	854	656	458	458	769	2449	1319	1089	504	1407
NYL	1014	2437	3011	2789	2789	1452	912	723	842	428	428	984	3006	1863	1674	717	1178
NYM	2677	174	101	274	271	241	2372	2414	2962	2869	2869	3137	442	1241	1661	2951	2161
NYN	1646	2149	2068	2147	2114	1149	1143	13	1485	1149	1129	1531	2645	1744	1774	1473	1427
NYO	1111	2027	1112	274	267	2495	1651	554	1746	1476	1476	1718	1284	2193	2167	1412	1412
NYP	2421	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYQ	1111	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYR	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYSE	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYF	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYG	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYH	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYI	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYJ	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYK	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYL	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYM	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYN	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYO	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYP	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYQ	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYR	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYSE	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYF	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYG	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYH	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYI	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYJ	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYK	274	1117	1117	142	142	1442	2427	2479	3004	2932	2932	3186	1118	1416	1773	2408	1242
NYL	274	1117	1117	142	142												

LOC	NQX	NTD	NUW	NZ1	NZY	OPP	OSC	PAM	PBG	PHL	PNE	PSM	PWT	RCA	RDR	RME	SAW
PAM	554	2379	2773	2266	2250	1141	1186	0	1427	1053	1053	1457	2752	1643	1637	1274	1344
PBG	1748	1016	2778	2947	2972	1378	590	1427	0	414	414	201	2794	1757	1798	156	825
PHL	1336	2922	2864	2839	2852	1296	636	1053	414	0	0	404	2869	1758	1479	296	918
PNE	1336	2922	2864	2839	2852	1296	636	1053	414	0	0	404	2869	1758	1479	296	918
PSM	1718	3186	2977	3113	3134	1543	770	1457	201	404	404	0	2992	1943	1594	287	1019
PWT	3288	1118	69	1199	1279	1665	2249	2752	2794	2869	2869	2992	0	1146	1401	2728	1978
RCA	2193	1318	1155	1280	1326	521	1174	1643	1757	1758	1758	1943	1146	0	442	1662	939
RDR	2187	1756	1390	1722	1769	547	850	1637	1398	1479	1479	1594	1401	442	0	1326	577
RME	1617	2898	2716	2826	2848	1256	488	1274	156	296	296	287	2728	1662	1326	0	749
SAW	1852	2332	1967	2176	2250	655	283	1444	825	918	918	1019	1978	939	577	749	0
GBD	2689	132	1212	61	136	1526	2315	2247	2902	2860	2860	3069	1147	1225	1666	2782	2126
SEA	3032	1156	285	1160	1238	1391	1971	2491	2529	2589	2589	2718	280	870	1125	2451	1702
SEF	1314	1511	2189	1388	1359	998	1593	937	2068	1799	1799	2170	2148	1269	1520	1916	1589
SGC	769	2652	2854	2550	2547	1179	905	462	1001	605	605	1008	2864	1699	1568	856	1134
SHF	3045	377	830	436	562	1670	2417	2554	3004	2966	2966	3186	762	1250	1659	2902	2190
SHL	1437	1750	1911	1663	1675	260	790	884	1335	1177	1177	1478	1896	764	792	1196	753
TCM	4275	1096	90	1177	1257	1657	2247	2740	2794	2865	2865	2992	22	1138	1400	2726	1977
TH	1479	1488	1873	1386	1385	594	1179	933	1692	1496	1496	1825	1845	820	1020	1549	1101
TSH	1973	2882	2938	2739	2794	1903	792	829	679	265	265	652	2937	1801	1579	554	1076
VAD	532	2519	2860	2408	2395	1292	114	166	1311	922	922	1325	2842	1716	1668	1162	1721
YFC	611	2406	2708	2193	2177	1066	1175	72	1445	1082	1082	1485	2686	1583	1591	1291	1319
WPP	681	2466	2750	2359	2351	1631	985	240	1188	813	813	1217	2735	1600	1531	1036	1121
WPI	1387	2965	2885	2842	2897	1314	649	1111	369	59	59	347	2892	1788	1497	265	632

LOC	SBD	SKA	SKP	SSC	SUU	SZL	TCM	TIK	TWH	VAD	VPS	WRB	WRI
ABQ	739	1229	738	1783	1042	909	1404	618	2023	1655	1448	1596	2131
AEX	1742	2074	461	865	2062	603	2307	477	1192	656	434	639	1409
BAD	1648	1957	434	917	1957	508	2190	359	1225	740	528	703	1421
BIX	2022	2317	709	643	2340	752	2558	732	998	389	160	408	1253
BYH	1872	1967	808	654	2119	343	2224	517	899	609	493	502	1060
CRM	1982	2152	791	552	2258	538	2404	632	859	430	291	352	1073
CHS	2558	2637	1329	88	2820	1020	2901	1202	419	272	482	233	725
COP	2639	2860	1309	450	2948	1236	3114	1324	750	284	466	411	1065
CVS	955	1401	536	1572	1268	744	1595	414	1827	1433	1224	1379	1954
DAG	2683	2536	1640	440	2869	1058	2810	1360	152	755	912	644	228
DCA	2683	2524	1651	463	2865	1057	2799	1364	176	778	931	664	210
DLH	1874	1425	1486	1303	1917	671	1700	985	1285	1439	1393	1294	1195
DMA	486	1336	899	2101	899	1273	1446	952	2365	1937	1718	1899	2490
DOV	2790	2597	1772	564	2962	1165	2873	1479	222	882	1045	775	97
DYS	1230	1683	263	1339	1566	661	1889	294	1628	1165	947	1130	1794
FEW	1010	922	1066	1705	1111	744	1164	676	1860	1672	1510	1573	1891
FFO	2228	2091	1293	549	2406	605	2364	936	569	740	777	590	617
FWH	1381	1767	278	1181	1703	561	1985	231	1474	1009	794	972	1647
GFA	1159	352	1706	2229	986	1300	628	1316	2307	2252	2115	2136	2260
GON	2980	2695	2024	830	3121	1368	2970	1702	472	1149	1314	1044	174
GSB	2679	2639	1533	228	2903	1076	2910	1327	142	543	731	460	451
GUS	2101	1940	1242	682	2266	490	2213	843	719	836	836	688	743
HIP	686	624	1325	2139	680	1180	806	1050	2300	2087	1910	1996	2326
HMN	777	1422	611	1787	1145	988	1581	648	2057	1623	1405	1584	2193
HST	2737	3034	1371	686	3070	1423	3282	1465	971	486	608	629	1285
IAB	1368	1482	679	1179	1594	265	1727	176	1388	1114	947	1024	1486
IND	2092	1975	1184	622	2272	469	2246	806	695	761	757	613	753
INH	2682	2531	1643	447	2867	1057	2806	1360	160	762	918	650	223
KBY	2507	2673	1220	268	2796	1046	2931	1168	614	123	352	209	921
LPI	2746	2630	1660	397	2946	1125	2905	1410	46	715	892	620	273
LGB	85	1154	1440	2599	452	1708	1158	1434	2836	2459	2244	2409	2926
LIC	3240	2749	2448	1341	3311	1703	3037	2065	991	1658	1808	1544	681
LRF	1709	1891	622	814	1979	332	2139	354	1083	797	536	630	1250
LSV	224	941	1292	2357	463	1438	1010	1197	2574	2243	2038	2180	2647
LUF	344	1207	1038	2199	744	1334	1302	1038	2448	2051	1836	2004	2556
NOG	452	778	1742	2750	29	1804	721	1608	2937	2661	2464	2587	2976
NOF	2523	2795	1176	523	2856	1193	3044	1232	859	261	371	410	1170
MEM	1975	1995	779	648	2130	376	2250	517	908	532	454	482	1081
MIB	1532	901	1585	1775	1478	940	1175	1104	1802	1955	1760	1723	1725
MTG	2338	2071	1517	741	2470	755	2347	1116	632	976	1031	828	544
MTO	750	376	1614	2399	554	1438	518	1336	2538	2363	2192	2267	2539
NOO	3033	2741	2077	872	3173	1422	3016	1757	510	1191	1360	1090	224
NEL	641	673	1603	2568	220	1617	685	1435	2748	2488	2295	2410	2784
NOH	2754	2654	1652	372	2959	1135	2928	1413	7	689	872	600	309
NOI	438	869	1774	2815	68	1874	796	1666	3010	2717	2516	2647	3056
NHE	2734	2580	1687	466	2919	1108	2855	1410	139	784	948	678	195
NIF	2515	2692	1220	296	2808	1065	2949	1180	638	128	352	231	946
NFO	2343	2169	1412	550	2511	722	2444	1058	491	786	853	639	500
NFT	2754	2728	1592	269	2998	1161	3000	1404	163	564	768	503	475
NFI	239	949	1482	2660	212	1733	920	1501	2870	2547	2342	2484	2943
NPA	2114	2347	806	560	2429	909	2642	814	921	292	63	326	1187
NPF	2689	3032	1414	769	3031	1477	1275	1449	1073	532	611	681	1387
NTD	112	1196	1511	2652	377	1756	1096	1488	2882	2519	2306	2466	2965
NTH	1212	285	2139	277	809	1911	90	1873	2945	2960	2708	2750	2885
NTI	61	1166	1348	2750	486	1663	1177	1386	2789	2408	2193	2359	2882
NTY	134	1238	1359	2547	562	1676	1257	1385	2794	2395	2177	2351	2897
OBP	1526	1391	998	1179	1673	260	1657	494	1903	1202	1086	1081	1334
OTI	2415	1971	1593	965	2417	790	2247	1159	782	1134	1175	985	649

LOC	SBD	SKA	SKF	SSC	SUU	SZL	TCM	TIK	TWH	VAD	VPS	WRB	WRI
PAM	2247	2491	937	462	2554	884	2740	933	829	166	72	240	1111
PBG	2902	2520	2068	1001	3004	1335	2794	1692	679	1311	1445	1188	369
PHL	2800	2589	1799	605	2966	1177	2865	1496	265	922	1082	813	59
PNE	2800	2589	1799	605	2966	1177	2865	1496	265	922	1082	813	59
PSM	3069	2718	2170	1008	3186	1478	2992	1825	652	1325	1485	1217	347
PWT	1147	280	2148	2844	762	1896	22	1845	2937	2842	2686	2735	2892
RCA	1225	870	1269	1699	1250	764	1138	820	1801	1716	1583	1600	1788
RDR	1666	1125	1520	1568	1659	792	1400	1020	1579	1668	1591	1531	1497
RNE	2782	2451	1916	856	2902	1196	2726	1549	554	1162	1291	1036	265
SAW	2126	1702	1580	1134	2190	743	1977	1101	1056	1321	1319	1171	931
SRD	0	1102	1381	2522	450	1626	1125	1357	2755	2387	2174	2334	2843
SKA	1102	0	1935	2569	803	1627	276	1598	2658	2576	2427	2466	2613
SKP	1381	1935	0	1325	1755	837	2131	505	1650	1098	869	1097	1854
SSC	2522	2569	1325	0	2773	961	2835	1165	368	318	504	235	661
SUU	450	803	1755	2773	0	1827	740	1628	2961	2681	2483	2608	3002
SZL	1626	1627	837	961	1827	0	1886	369	1137	952	827	839	1222
TCM	1125	276	2131	2835	740	1886	0	1831	2931	2831	2674	2725	2889
TIK	1357	1598	505	1165	1628	369	1831	0	1413	1053	863	983	1546
TWH	2755	2658	1650	368	2961	1137	2931	1413	0	684	868	596	315
VAD	2387	2576	1098	318	2681	952	2831	1053	684	0	230	150	979
VPS	2174	2427	869	504	2483	827	2674	863	868	230	0	272	1140
WRB	2334	2466	1097	235	2608	839	2725	983	596	150	272	0	871
WRI	2843	2613	1854	661	3002	1222	2889	1546	315	979	1140	871	0

Appendix H: Hub Locations

QUICKTRANS Hub Locations

Shows potential hub locations with closest associated delivery locations and air statute miles.

NIP		CHS		NGU		SUU		NZY	
LOC Miles		LOC Miles		LOC Miles		LOC Miles		LOC Miles	
COF	152	CHS	0	DAG	122	NFL	183	LGB	92
KBY	23			DCA	141	NGZ	57	NTD	160
NIP	0			GON	389	NLC	177	NZJ	67
NPA	345			IND	577	NUW	692	NZY	0
NQX	400			INH	128	PWT	635	SBD	113
				NCO	421	SUU	0		
				NGU	0	TCM	617		
				NHK	110				
				NKT	142				
				PHL	216				
				PNE	216				
				TWH	6				
				WRI	257				

LOGAIR Hub Locations

Shows potential hub locations with closest associated delivery locations and air statute miles.

FFO	SUU	SBD	TIK	SKF	HIF
LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles
BYH 406	SUU 0	DMA 405	BAD 299	AEX 384	ABQ 505
DLH 632		LSV 187	CVS 345	DYS 219	FEW 367
DOV 468		LUF 286	FWH 193	HMN 509	GFA 430
FFO 0		SBD 0	IAB 146	SKF 0	HIF 0
GUS 125			LRF 295		MIB 709
LFI 455			OFF 412		MUO 243
LIZ 962			SZL 308		RCA 480
MTC 213			TIK 0		RDR 836
NKO 102					SKA 520
OSC 332					
PBG 646					
PSM 743					
RME 520					
SAW 491					
WRI 515					

MCC	WRB
LOC Miles	LOC Miles
MCC 0	BIX 340
TCM 601	CBM 293
	CHS 194
	COF 343
	GSB 384
	HST 524
	MCF 342
	MEM 402
	NIP 193
	NQX 567
	PAM 200
	SSC 196
	VAD 125
	VPS 227
	WRB 0

Combined Route Structure Hub Locations

Shows potential hub locations with closest associated delivery locations and air statute miles.

CHS	DOV	FFO	HIF	MCC	NGU
LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles
CHS 0	DAG 112	BYH 406	ABQ 505	MCC 0	GSB 123
SSC 73	DCA 101	DLH 632	FEW 367	NFL 161	LFI 33
	DOV 0	FFO 0	GFA 430		NGU 0
	INH 109	GUS 125	HIF 0		NKT 142
	NHK 82	IND 114	MIB 709		TWH 6
	PHL 36	MTC 213	MUO 243		
	PNE 36	NKO 102	RCA 480		
		OSC 332	RDR 836		
		SAW 491			

NIP	NZY	SBD	SKF	SUU	TCM
LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles	LOC Miles
COF 152	DMA 385	LGB 71	AEX 384	NGZ 57	NUW 75
HST 342	NZY 0	LSV 187	DYS 219	NLC 177	PWT 19
KBY 23		LUF 286	HMN 509	SUU 0	SKA 230
MCF 190		NTD 110	SKF 0		TCM 0
NIP 0		NZJ 51			
NQX 400		SBD 0			
VAD 107					

TIK	WRB	WRI
LOC Miles	LOC Miles	LOC Miles
BAD 299	BIX 340	GON 145
CVS 345	CBM 293	LIZ 567
FWH 193	MEM 402	NCO 187
IAB 146	NPA 271	PBG 307
LRF 295	PAM 200	PSM 289
OFF 412	VPS 227	RME 221
SZL 308	WRB 0	WRI 0
TIK 0		

Appendix I: Sorted Hub Groupings

QUICKTRANS Hub Routings

1. QUICKTRANS TRAVIS HUB ROUTING.

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	NLC	LEMOORE	36.15	119.57	0.0000	3,255
2	SUU	TRAVIS (HUB)	38.16	121.56	0.0625	38,594
3	NGZ	OAKLAND	37.47	122.13	0.0625	4,223
4	TCM	MCCHORD AFB	47.08	122.28	0.6875	7,196
5	PWT	BREMERTON	47.34	122.38	0.6875	5,510
6	NUW	WHIDBEY ISL	48.17	122.37	0.6875	4,001
7	NFL	FALLON	39.28	118.47	0.9375	1,329

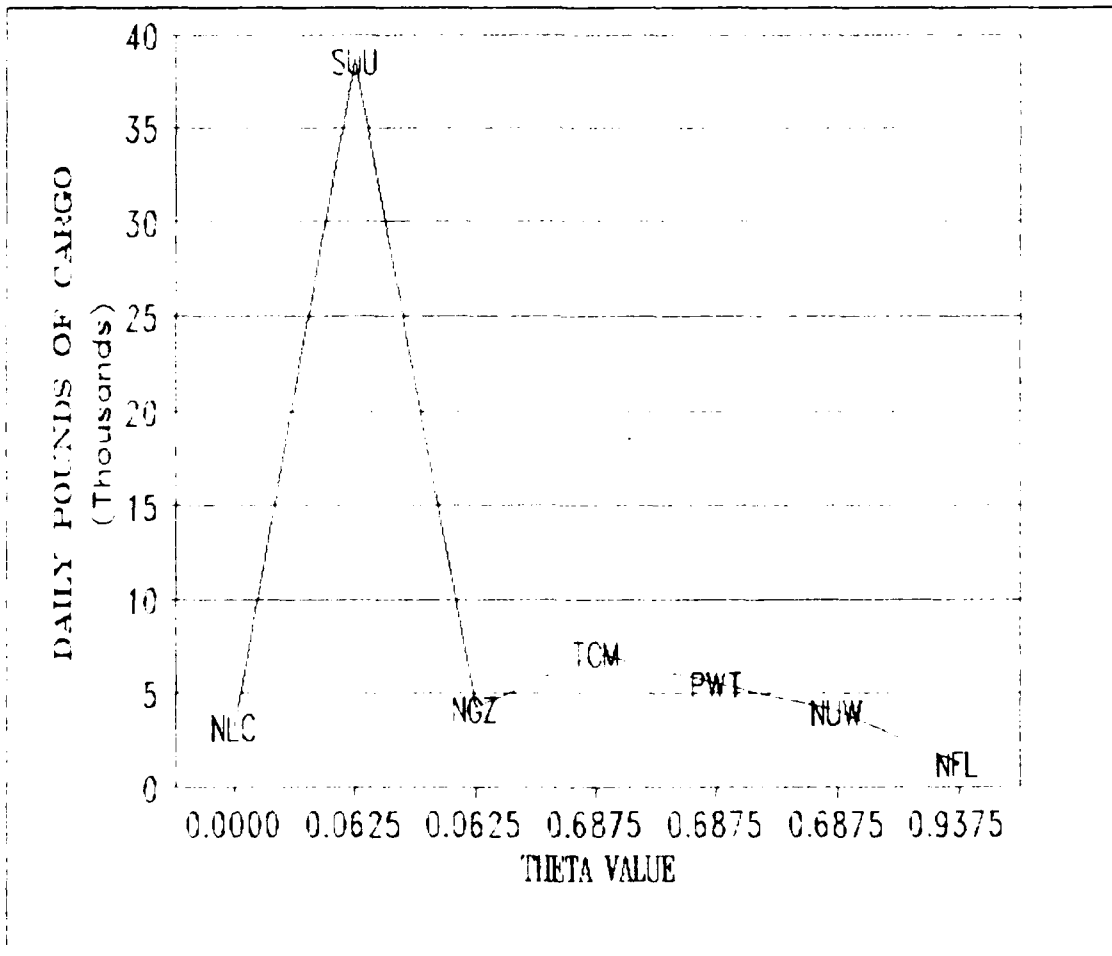


Figure 19: Spacefilling Curve QUICKTRANS Travis hub routing

2. QUICKTRANS SAN DIEGO HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	NZY	SAN DIEGO (HUB)	32.42	117.12	0.0000	40,072
2	LGB	LONG BEACH	33.45	118.14	0.3750	10,626
3	NTD	POINT MUGU	34.07	119.07	0.5000	3,592
4	SBD	SAN BERNADINO	34.06	117.17	0.7500	3,206
5	NZJ	EL TORO	33.36	117.40	0.9375	548

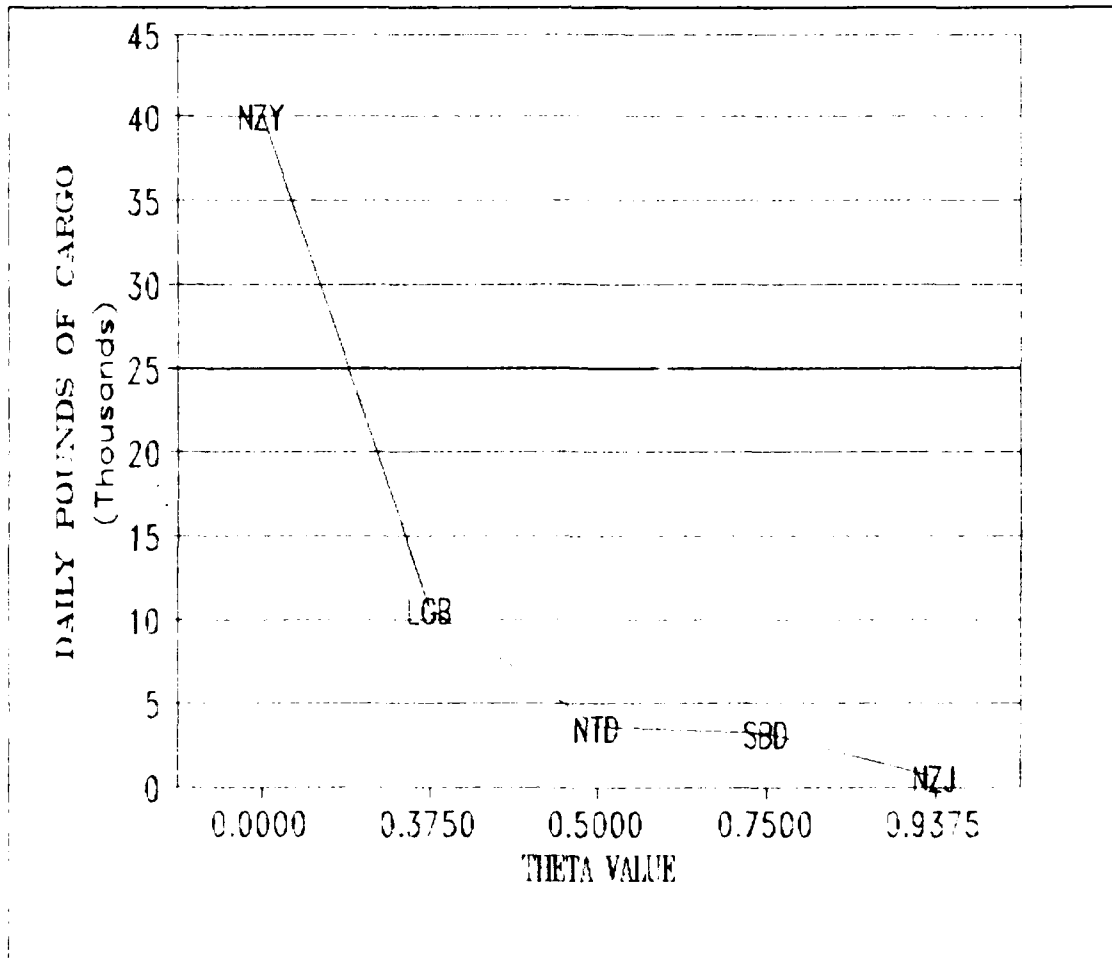


Figure 20: Spacefilling Curve QUICKTRANS San Diego hub routing

3. QUICKTRANS NORFOLK HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	NGU	NORFOLK (HUB)	36.57	76.18	0.0625	53,378
2	TWH	NAVAL SHIPYARD	36.49	76.18	0.0625	1,175
3	NHK	PATUXENT RIVER	38.17	76.25	0.0625	4,649
4	NKT	CHERRY POINT	34.54	76.54	0.0625	9,862
5	DAG	DAHLGREN	38.20	77.03	0.0625	1,096
6	IND	WEIR COOK AP	39.43	86.16	0.3125	4,135
7	INH	INDIAN HEAD	38.30	77.03	0.8750	1,096
8	DCA	WASHINGTON	38.51	77.00	0.8750	3,625
9	PHL	PHILADELPHIA-1	39.57	75.07	0.8750	3,562
10	PNE	PHILADELPHIA-2	39.57	75.07	0.8750	266
11	WRI	MCGUIRE APB	40.01	74.36	0.9375	1,991
12	NCO	NEWPORT	41.28	71.20	0.9375	1,515
13	GON	NEW LONDON	41.21	72.07	0.9375	4,394

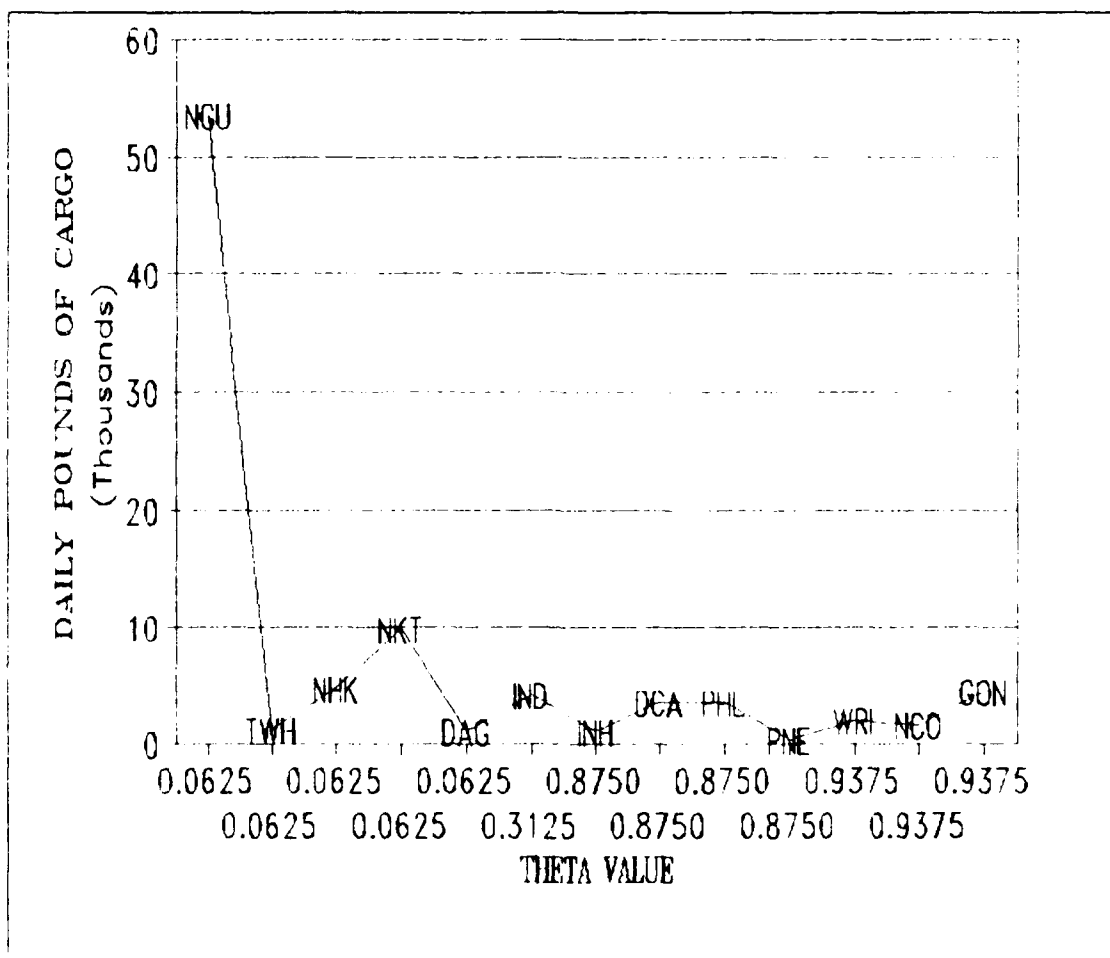


Figure 21: Spacefilling Curve QUICKTRANS Norfolk hub routing

4. QUICKTRANS JACKSONVILLE HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	NQX	KEY WEST	24.34	81.41	0.0000	1,675
2	NPA	PENSOCOLA	30.21	87.19	0.5000	10,607
3	NIP	JACKSONVILL(HUB)	30.14	81.40	0.7500	20,541
4	KBY	KINGS BAY	30.48	81.40	0.7500	1,408
5	COF	CAPE CANAVERAL	28.14	80.36	0.8125	1,089

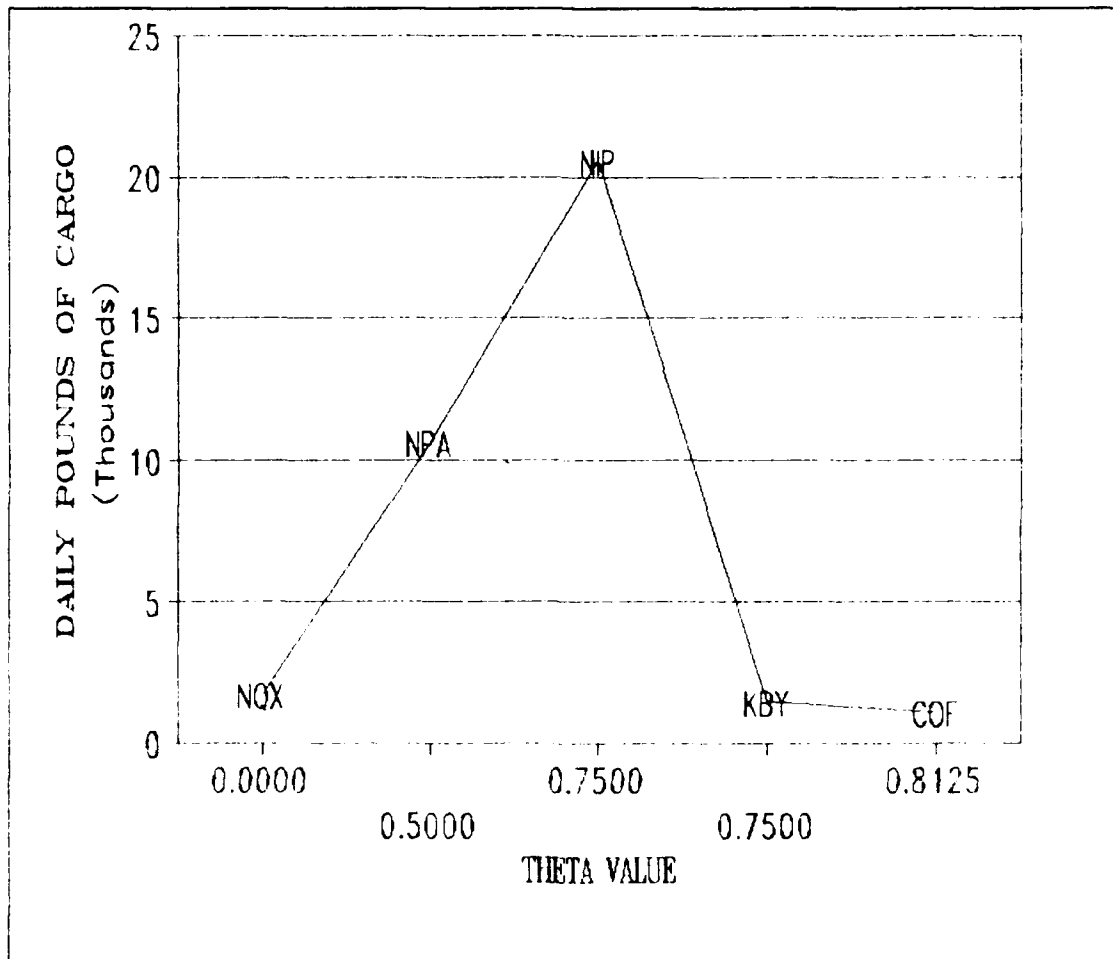


Figure 22: Spacefilling Curve QUICKTRANS Jacksonville hub routing

5. QUICKTRANS MAIN HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	NIP	JACKSONVILLE	30.14	81.40	0.0000	20,541
2	CHS	CHARLESTON	32.53	80.02	0.0000	17,723
3	NZY	SAN DIEGO	32.42	117.12	0.2500	40,072
4	NGZ	OAKLAND	37.47	122.13	0.2656	4,223
5	SUU	TRAVIS AFB	38.16	121.56	0.2656	38,594
6	NGU	NORFOLK	36.57	76.18	0.9844	53,378

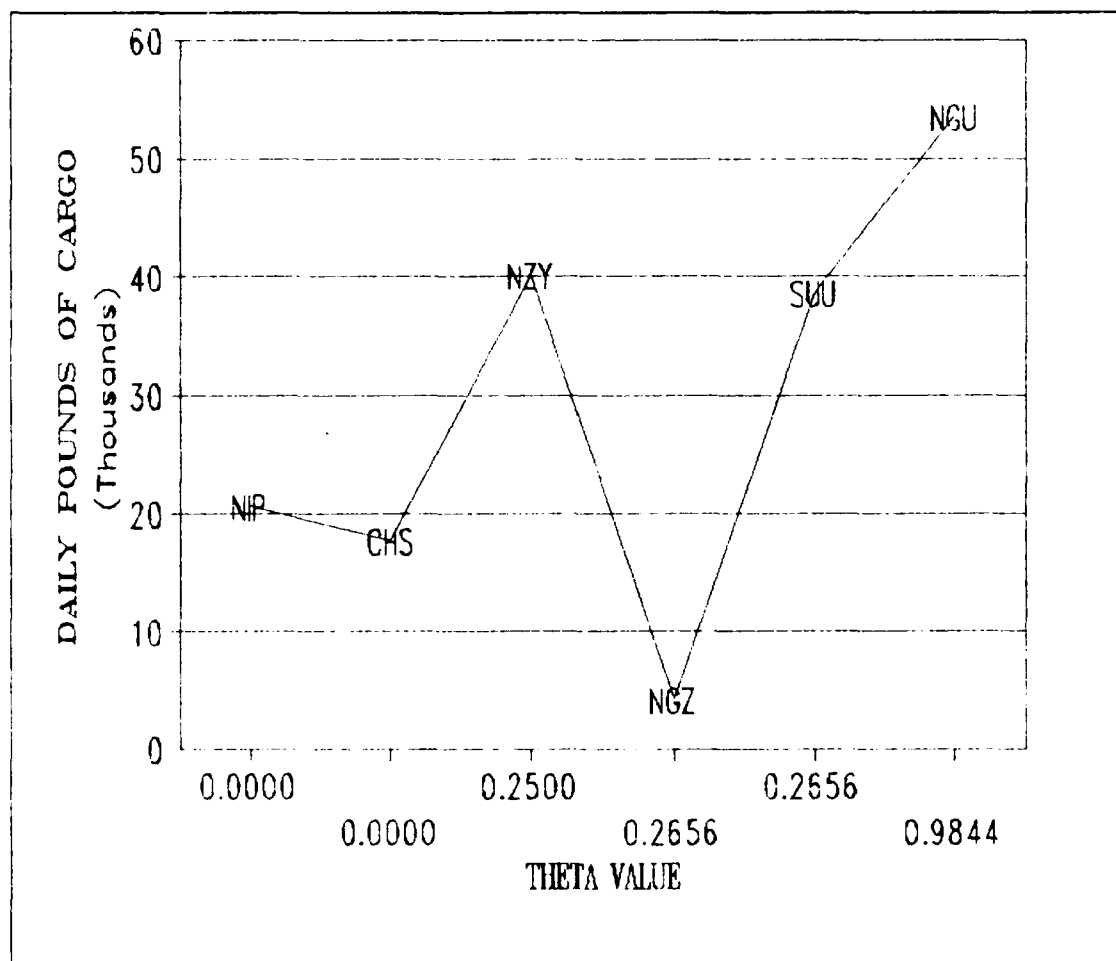


Figure 23: Spacefilling Curve QUICKTRANS main hub routing

LOGAIR Hub Routings

1. LOGAIR MAIN HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	WRB	ROBINS	32.38	83.35	0.0000	22,661
2	TIK	TINKER	35.25	97.23	0.0625	34,308
3	SKF	KELLY	29.23	98.35	0.0625	31,959
4	HIF	HILL	41.08	111.58	0.1250	26,907
5	SUU	TRAVIS	38.16	121.56	0.2500	11,556
6	MCC	MCCLELLAN	38.40	121.24	0.2500	22,912
7	SBD	NORTON	34.06	117.14	0.2500	12,975
8	FFO	WRIGHT-PATT	39.49	84.03	0.9375	14,867

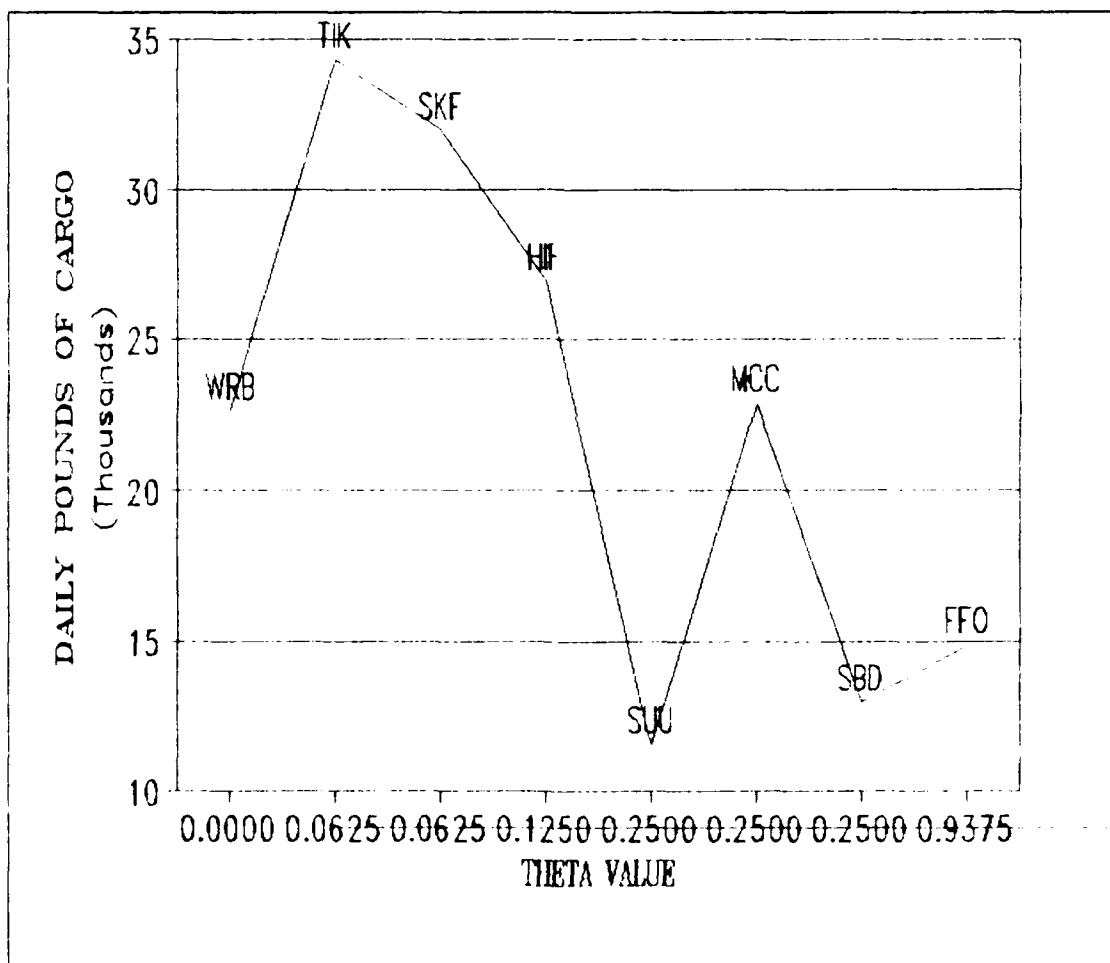


Figure 24: Spacefilling Curve LOGAIR main hub routing

2. LOGAIR WRIGHT-PATTERSON AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	RME	GRIFFISS	43.14	75.24	0.0313	2,820
2	LFI	LANGLEY	37.05	76.22	0.4688	3,645
3	WRI	MCGUIRE	40.01	74.35	0.4688	8,486
4	DOV	DOVER	39.08	75.28	0.4688	8,091
5	MTC	SELPRIDGE	42.36	82.50	0.1719	896
6	NKO	NEWARK	40.04	82.24	0.1875	127
7	FFO	WPAPB (HUB)	39.49	84.03	0.2031	14,867
8	GUS	GRISSOM	40.39	86.08	0.2188	90
9	SAW	K.I. SAWYER	46.21	87.23	0.2813	1,501
10	DLH	DULUTH	46.50	92.11	0.3125	525
11	OSC	WURTSMITH	44.27	83.24	0.3438	1,821
12	PBG	PLATTSBURGH	44.39	73.28	0.9063	3,108
13	LIZ	LORING	46.57	67.53	0.9375	2,007
14	PSM	PEASE	43.04	70.49	0.9844	3,574

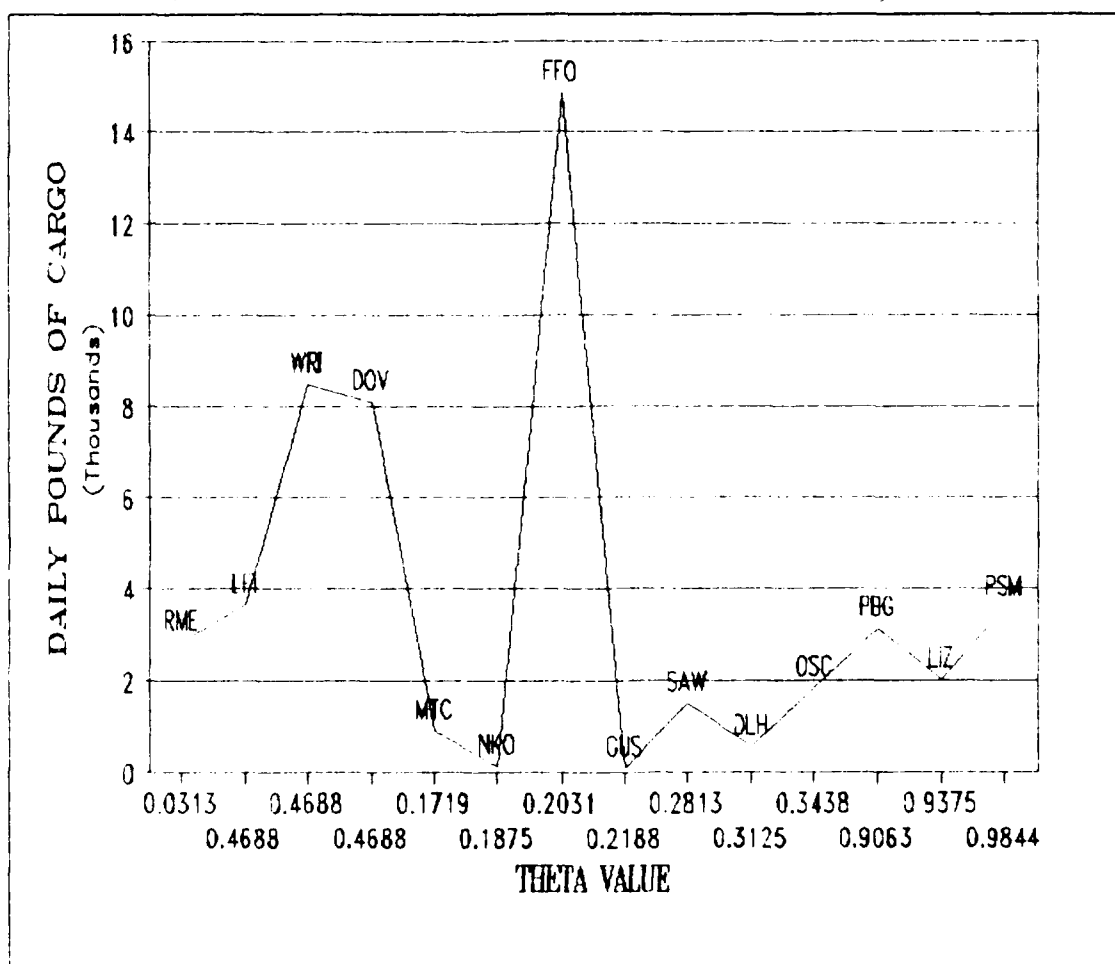


Figure 25: Spacefilling Curve LOGAIR Wright-Patterson hub routing

3. LOGAIR HILL AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	FEW	FRANCIS E.W.	41.08	104.52	0.0625	2,424
2	ABQ	KIRTLAND	35.02	106.36	0.0625	927
3	MUO	MOUNTAIN HOME	43.03	115.52	0.1250	1,985
4	GFA	MALMSTROM	47.30	111.11	0.1250	3,028
5	HIF	HILL (HUB)	41.08	111.58	0.1875	26,907
6	TCM	MCCHORD	47.08	122.28	0.3125	7,406
7	SKA	FAIRCHILD	47.37	117.39	0.3125	1,844
8	MIB	MINOT	48.25	101.21	0.8125	2,934
9	RDR	GRAND FORKS	47.57	97.24	0.8125	2,424
10	RCA	ELLSWORTH	44.09	103.06	0.9375	3,721

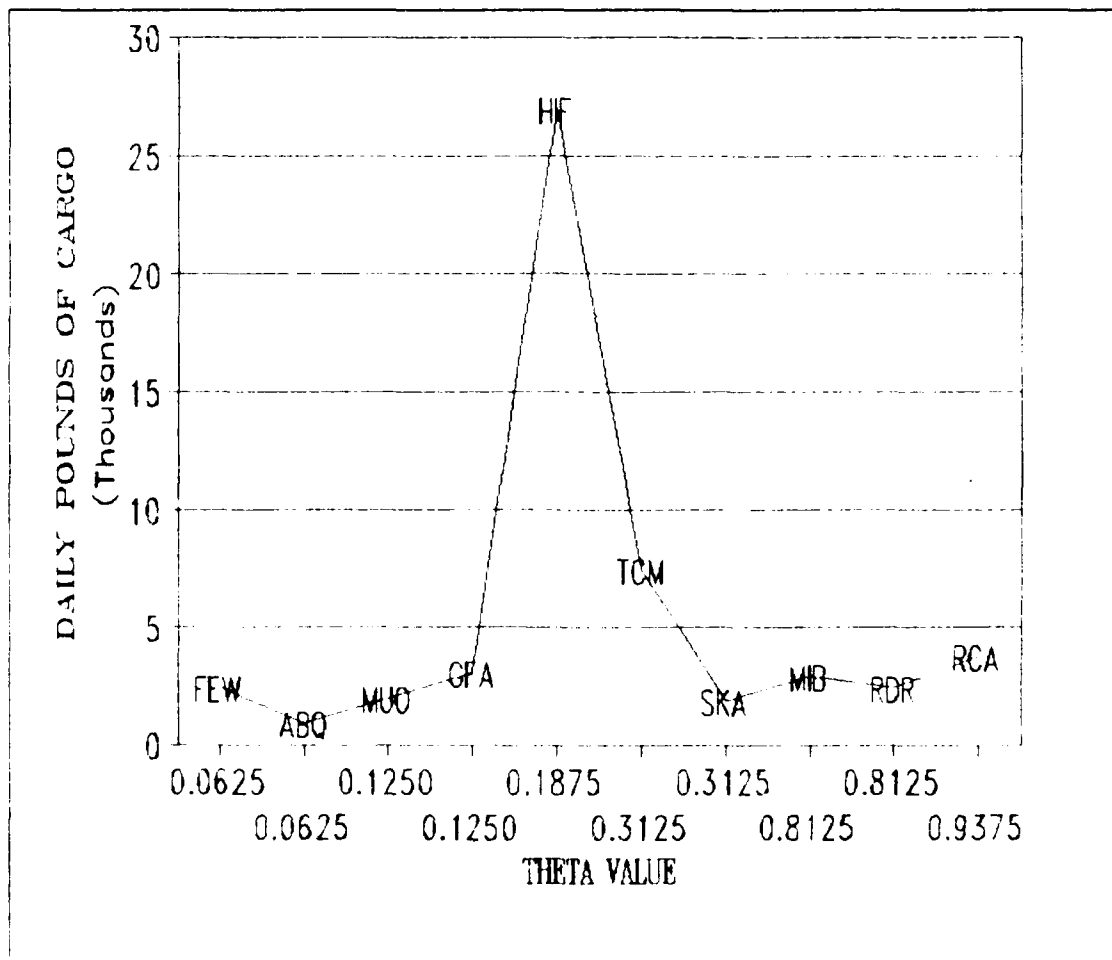


Figure 26: Spacefilling Curve LOGAIR Hill hub routing

4. LOGAIR NORTON AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	DMA	DAVIS-MONTHAM	32.10	110.53	0.0000	2,570
2	LUF	LUKE	33.32	112.23	0.0625	4,104
3	SBD	NORTON (HUB)	34.06	117.14	0.3125	12,975
4	LSV	NELLIS	36.14	115.02	0.3750	2,946

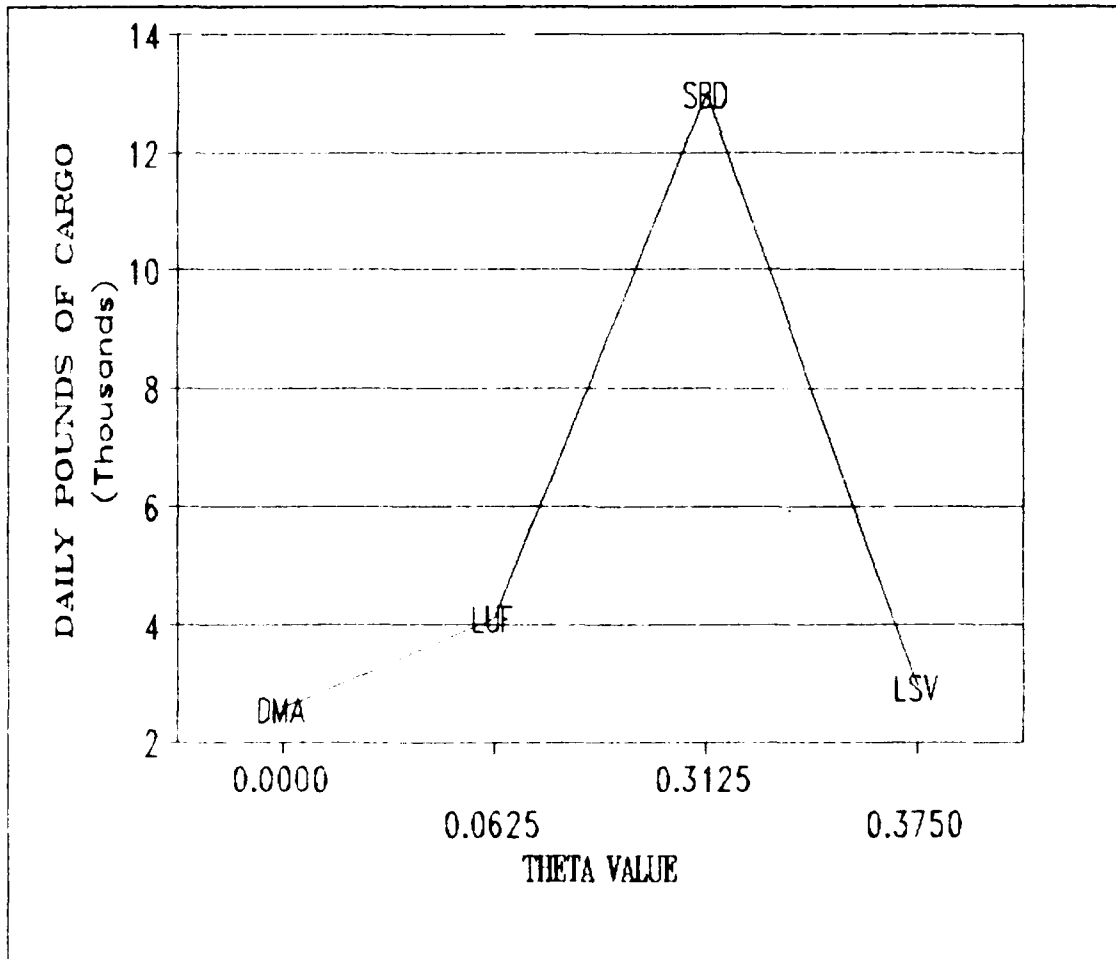


Figure 27: Spacefilling Curve LOGAIR Norton hub routing

5. LOGAIR KELLY AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	AEX	ENGLAND	31.20	92.33	0.0000	793
2	SKF	KELLY (HUB)	29.23	98.35	0.0625	31,959
3	DYS	DYESS	32.25	99.51	0.1875	2,584
4	HMN	HOLLOMAN	32.51	106.06	0.2500	3,421

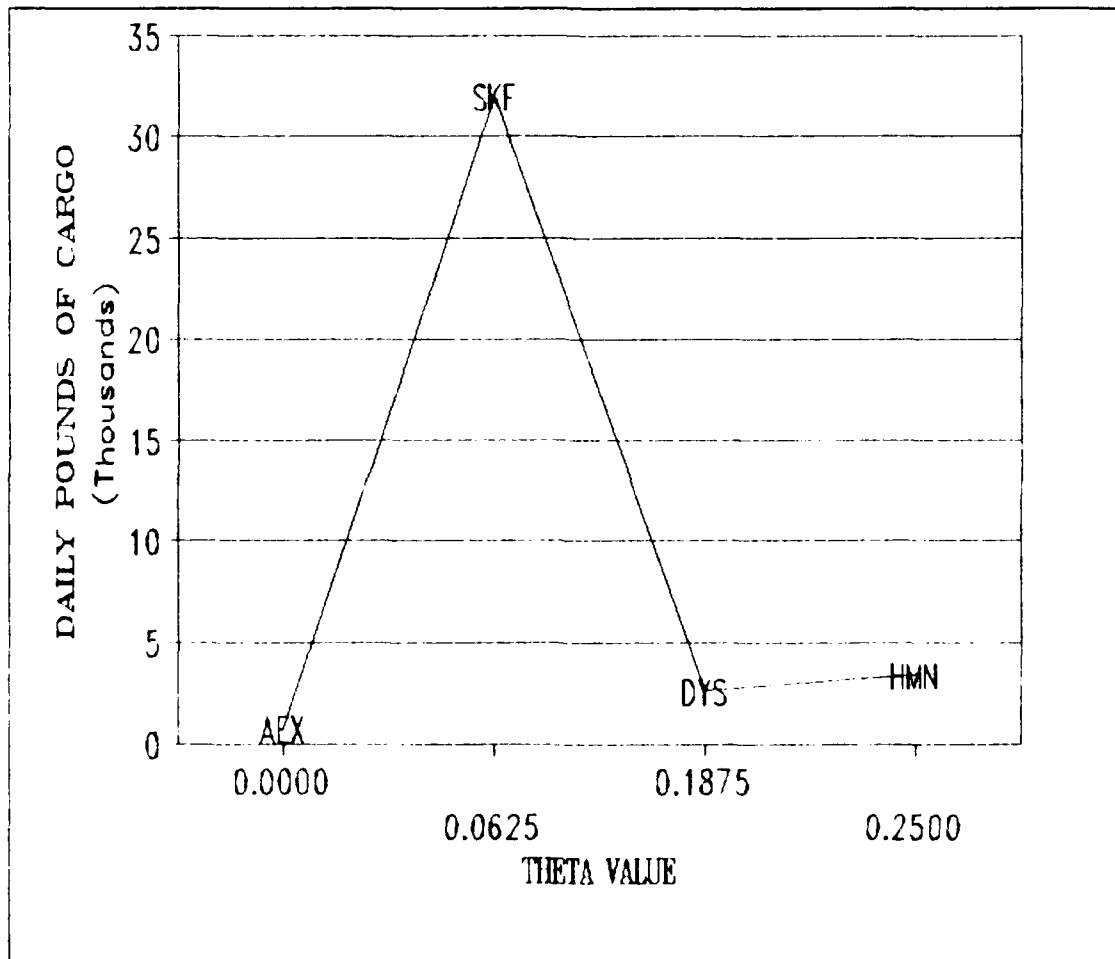


Figure 28: Spacefilling Curve LOGAIR Kelly hub routing

6. LOGAIR TINKER AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	LRF	LITTLE ROCK	34.55	92.08	0.0000	3,413
2	BAD	BARKSDALE	32.30	93.40	0.0000	3,216
3	FWH	CARSWELL	32.46	97.26	0.0625	3,629
4	CVS	CANNON	34.23	103.19	0.2500	1,521
5	OFF	OFFUTT	41.07	95.55	0.6875	2,299
6	SZL	WHITEMAN	38.44	93.33	0.8125	1,722
7	TIK	TINKER (HUB)	35.25	97.23	0.8750	34,308
8	IAB	MCCONNELL	37.37	97.16	0.8750	2,190

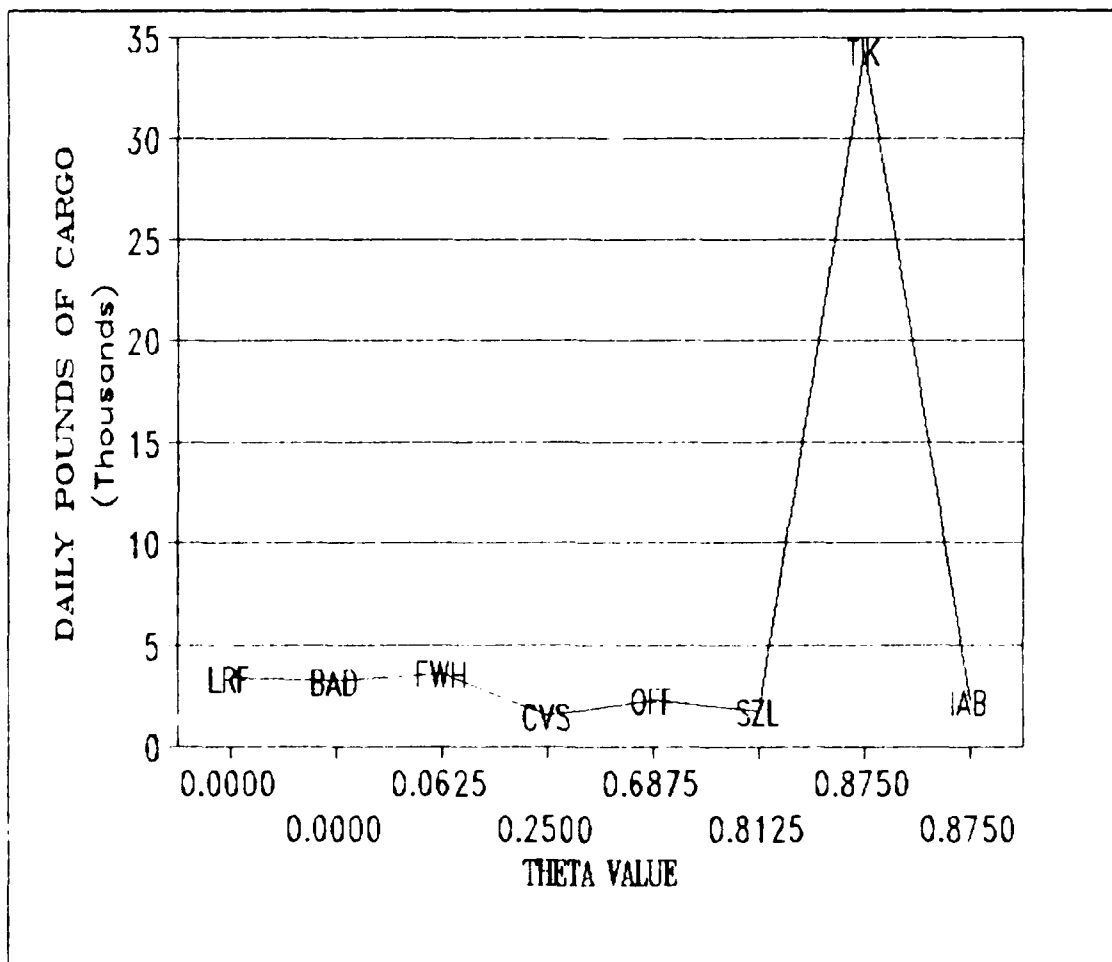


Figure 29: Spacefilling Curve LOGAIR Tinker hub routing

7. LOGAIR WARNER ROBINS AFB HUB ROUTING

RANK	CODE	BASE	LAT	LONG	THETA	DAILY LBS
1	HST	HOMESTEAD	25.29	80.23	0.0156	2,572
2	NQX	KEY WEST	24.34	81.41	0.0469	90
3	MCF	MACDILL	27.51	82.31	0.1094	1,742
4	BIX	KEESLER	30.25	88.55	0.3125	1,452
5	PAM	TYNDALL	30.04	85.35	0.3594	1,939
6	VPS	EGLIN	30.29	86.32	0.3594	5,188
7	CBM	COLUMBUS MS	33.39	88.26	0.4844	895
8	BYH	IRA EAKER	35.58	89.57	0.5000	1,328
9	MEM	MEMPHIS	35.03	89.58	0.5000	599
10	VAD	MOODY	30.58	83.12	0.6250	1,618
11	WRB	ROBINS (HUB)	32.38	83.35	0.6406	22,661
12	SSC	SHAW	33.58	80.28	0.7188	3,455
13	GSB	SEYMOUR JOHNSON	35.20	77.58	0.7500	3,580
14	CHS	CHARLESTON	32.54	80.02	0.7813	5,996
15	NIP	JACKSONVILLE	30.14	81.40	0.8906	1,684
16	CCF	PATRICK	28.14	80.36	0.9063	1,036

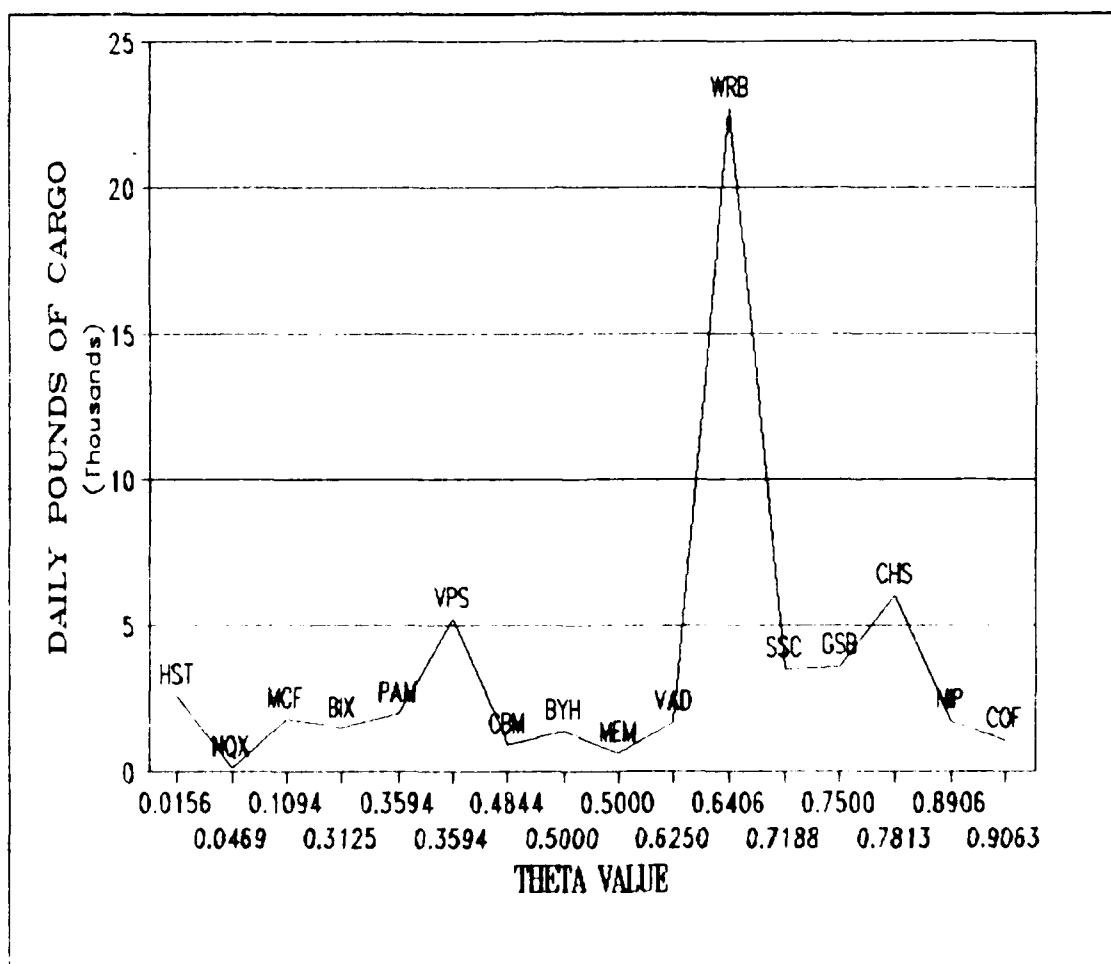


Figure 30: Spacefilling Curve LOGAIR Robins hub routing

Combined Route Model Hub Routings

1. Combined Route Model Combined Hub Routings

RANK CODE	NAME	LAT	LONG	THETA	DAILY LBS
1 CHS	CHARLESTON	32.54	80.02	0.00000	23,719
2 WRB	ROBINS	32.38	83.35	0.01563	22,661
3 NIP	JACKSONVILLE	30.14	81.40	0.01563	22,225
4 SKP	KELLY	29.23	98.35	0.06250	31,959
5 TIK	TINKER	35.25	97.23	0.07813	34,308
6 HIF	HILL	41.08	111.58	0.21875	26,907
7 LGB	LONG BEACH	33.45	118.14	0.25000	10,626
8 NZY	SAN DIEGO	32.42	117.12	0.25000	40,072
9 SBD	NORTON	34.06	117.14	0.25000	16,181
10 SUU	TRAVIS AFB	38.16	121.56	0.26563	50,150
11 MCC	MCCLELLAN	38.40	121.24	0.26563	22,912
12 TCM	MCCHORD AFB	47.08	122.28	0.29688	14,602
13 FPO	WRIGHT-PATTERSON	39.49	84.03	0.96875	14,867
14 NGU	NORFOLK	36.57	76.18	0.98438	53,378
15 WRI	MCGUIRE	40.01	74.35	0.98438	10,477
16 DOV	DOVER	39.08	75.28	0.98438	8,091

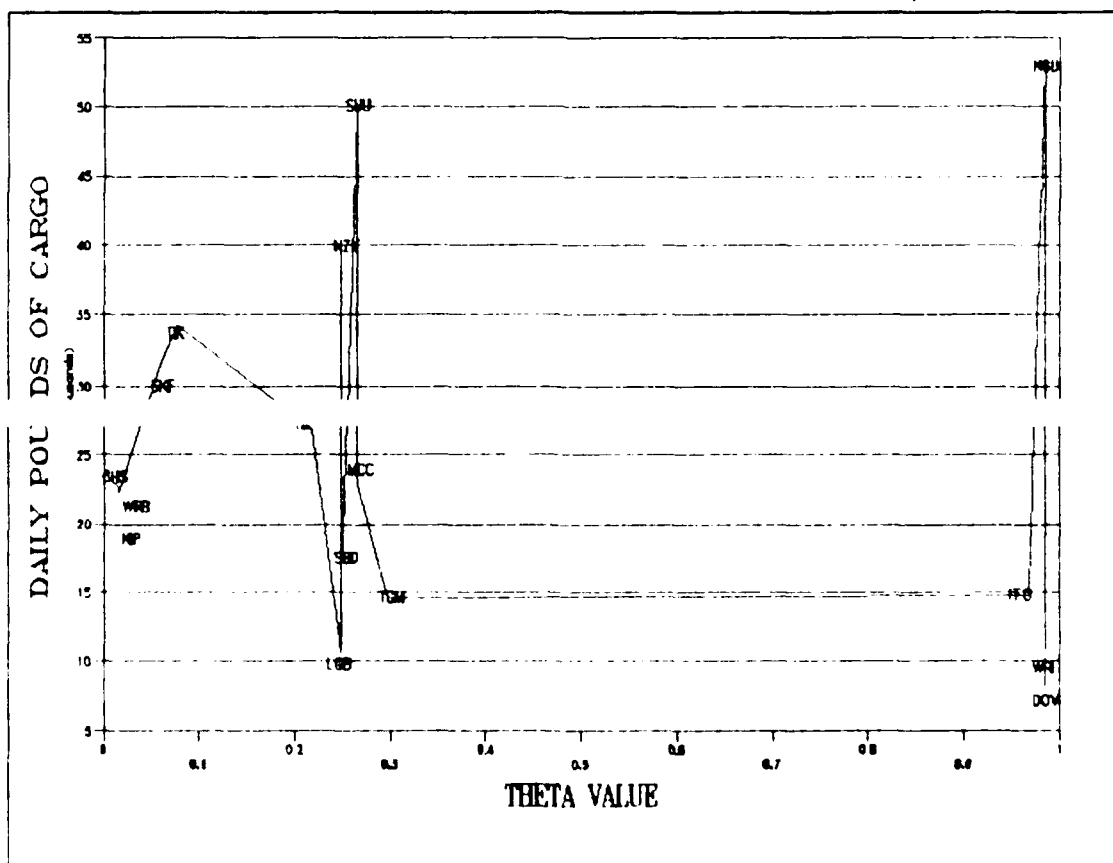


Figure 31: Spacefilling Curve Combined Route Model hub routings

2. Combined Route Model Dover Hub Routings

RANK CODE	NAME	LAT	LONG	THETA	DAILY LBS
1 NHK	PATUXENT RIVER	38.17	76.25	0.18750	4,649
2 DAG	DAHLGREN	38.20	77.03	0.25000	1,096
3 INH	INDIAN HEAD	38.30	77.03	0.25000	1,096
4 DCA	WASHINGTON	38.51	77.00	0.26563	3,625
5 PHL	PHILADELPHIA-1	39.57	75.07	0.79688	3,562
6 PNE	PHILADELPHIA-2	39.57	75.07	0.79688	266
7 DOV	DOVER (HUB)	39.08	75.28	0.93750	8,091

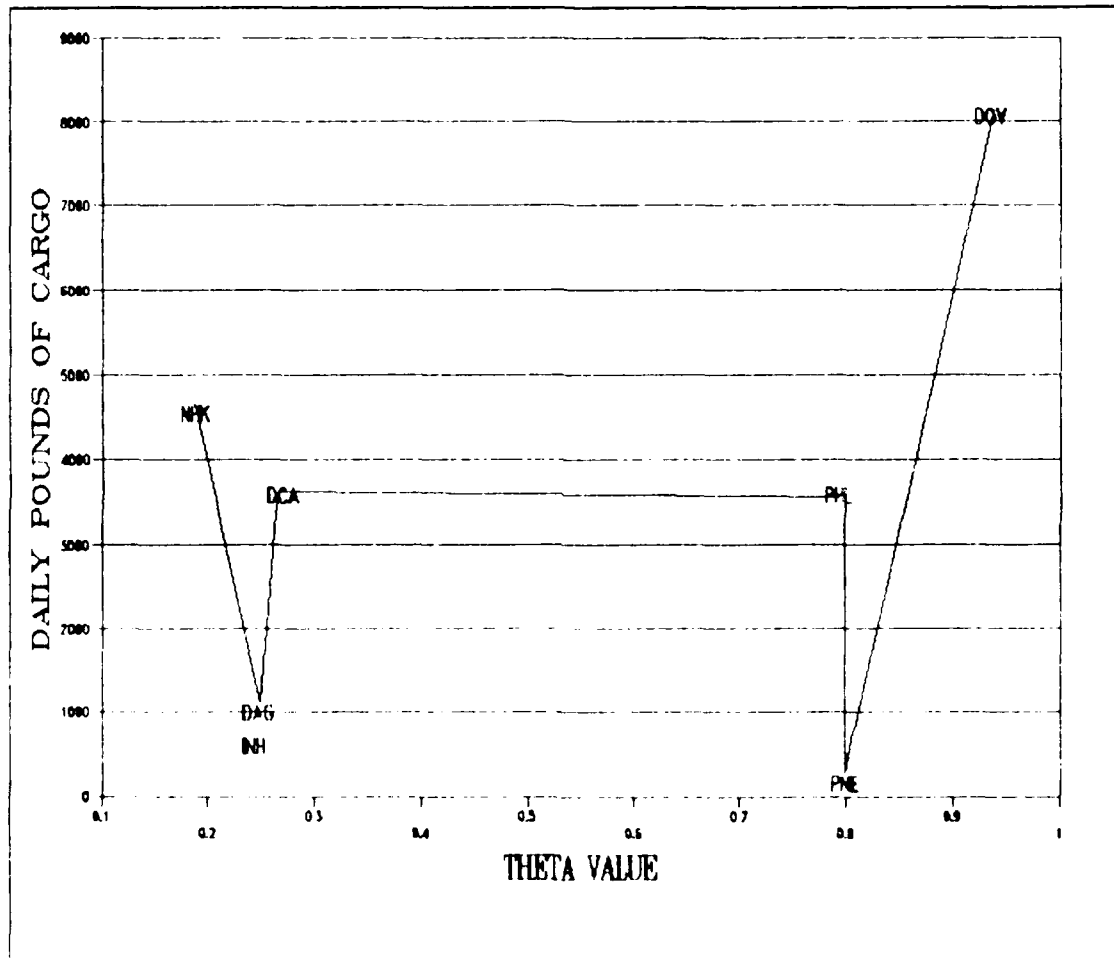


Figure 32: Spacefilling Curve Combined Route Model Dover hub routing

3. Combined Route Model WPAPB Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	NKO	NEWARK	40.04	82.24	0.00000	127
2	PFO	WPAPB (HUB)	39.49	84.03	0.01563	14,867
3	IND	WEIR COOK AP	39.43	86.16	0.06250	4,135
4	GUS	GRISSOM	40.39	86.08	0.06250	90
5	DLH	DULUTH	46.50	92.11	0.45313	525
6	SAW	K.I. SAWYER	46.21	87.23	0.60938	1,507
7	OSC	WURTSMITH	44.27	83.24	0.93750	1,821
8	MTC	SELFRIDGE	42.36	82.50	0.95313	896

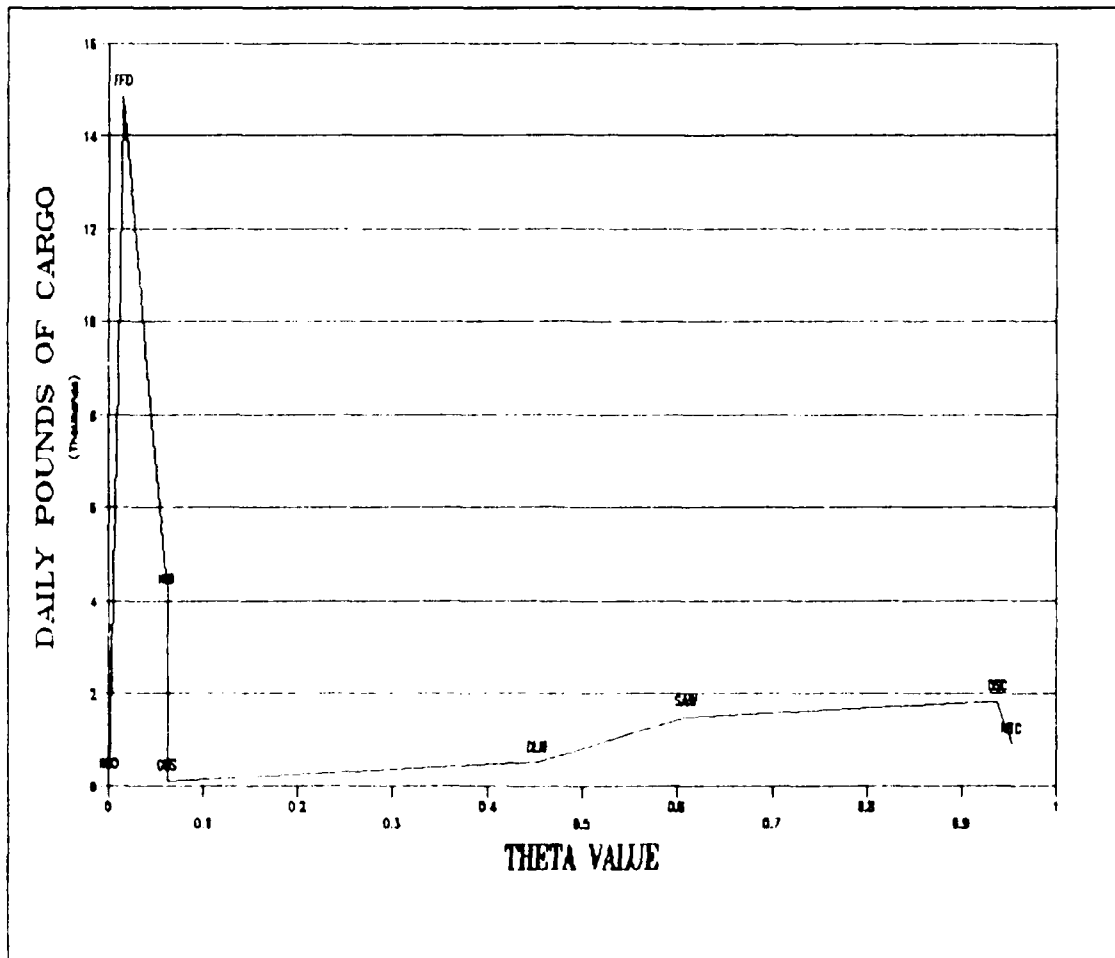


Figure 33: Spacefilling Curve Combined Route Model Wright-Patterson hub routing

4. Combined Route Model Hill Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	RCA	ELLSWORTH	44.09	103.06	0.03125	3,721
2	FEW	FRANCIS E.W.	41.08	104.52	0.06250	2,424
3	HIF	HILL (HUB)	41.08	111.58	0.23438	26,907
4	MUO	MOUNTAIN HOME	43.03	115.52	0.25000	1,985
5	GFA	MALMSTROM	47.30	111.11	0.28125	3,028
6	MIB	MINOT	48.25	101.21	0.92188	2,934
7	RDR	GRAND FORKS	47.57	97.24	0.95313	2,424

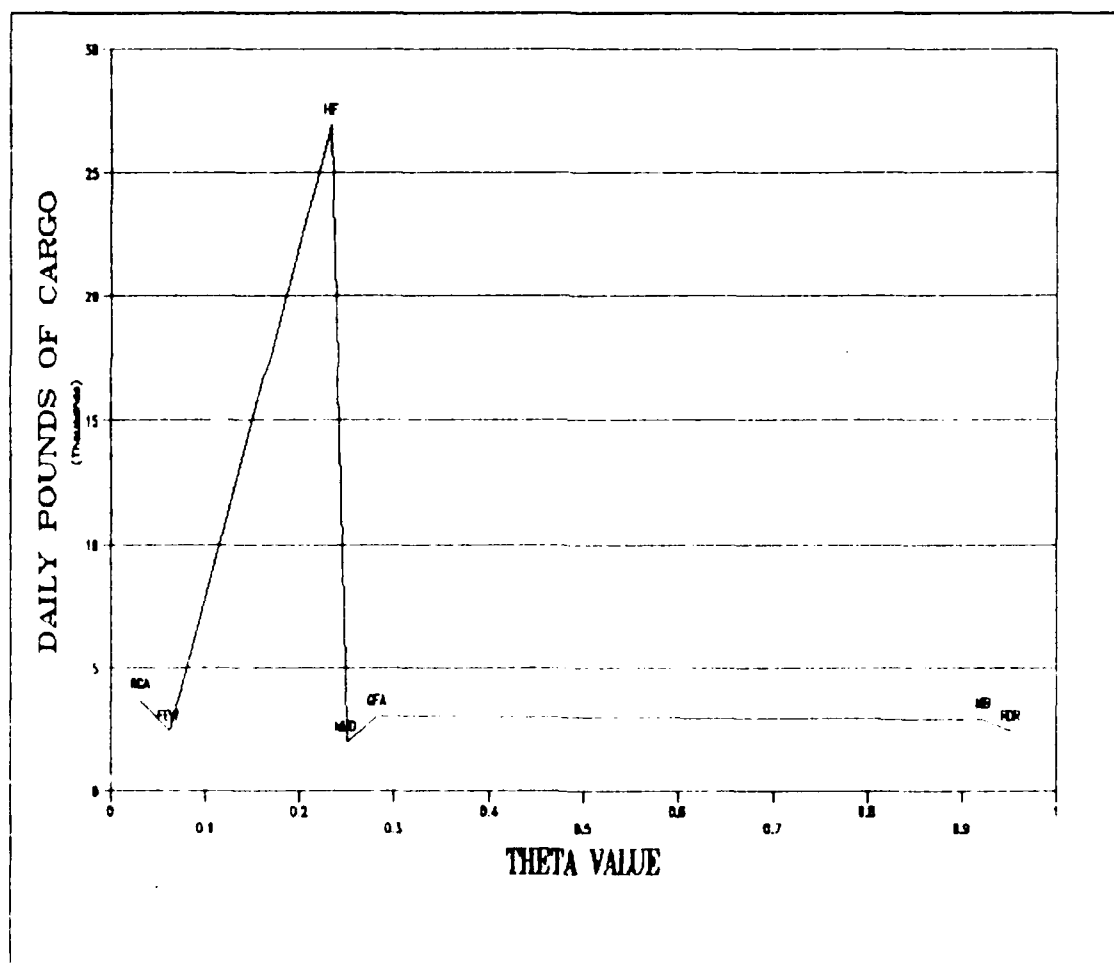


Figure 34: Spacefilling Curve Combined Route Model Hill hub routing

5. Combined Route Model Norfolk Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	GSB	SEYMOUR JOHNSON	35.20	77.58	0.06250	3,580
2	NHK	PATUXENT RIVER	38.17	76.25	0.75000	4,649
3	LFI	LANGLEY	37.05	76.22	0.81250	3,645
4	NGU	NORFOLK (HUB)	36.57	76.18	0.93750	53,378
5	TWH	NAVAL SHIPYARD	36.49	76.18	0.93750	1,175

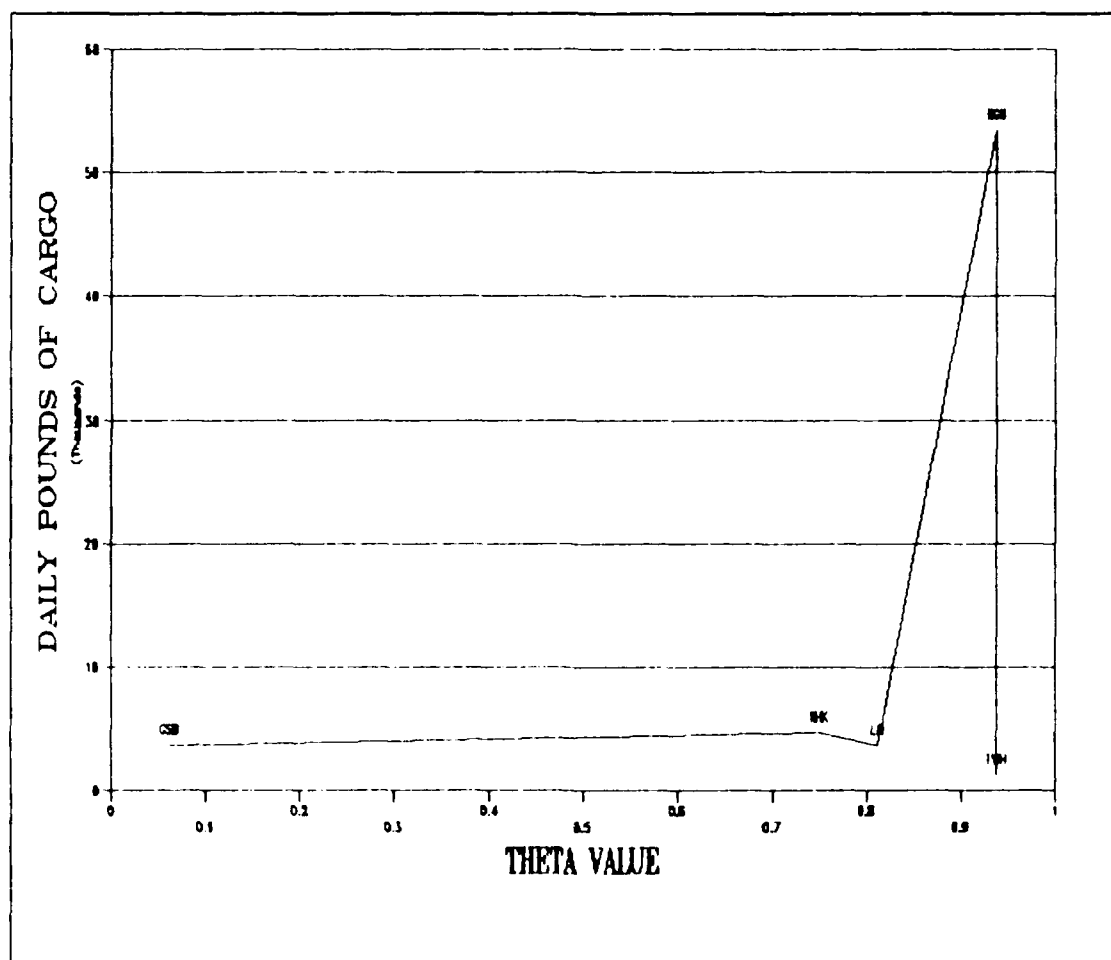


Figure 35: Spacefilling Curve Combined Route Model Norfolk hub routing

6. Combined Route Model Jacksonville Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	NQX	KEY WEST	24.34	81.40	0.01563	1,764
2	VAD	MOODY	30.58	83.12	0.68750	1,618
3	KBY	KINGS BAY	30.48	81.40	0.73438	1,408
4	NIP	JACKSONVI (HUB)	30.14	81.40	0.73438	22,225
5	COP	PATRICK	28.14	80.36	0.81250	2,125
6	MCP	MACDILL	27.51	82.31	0.85938	1,742
7	HST	HOMESTEAD	25.29	80.23	0.98438	2,572

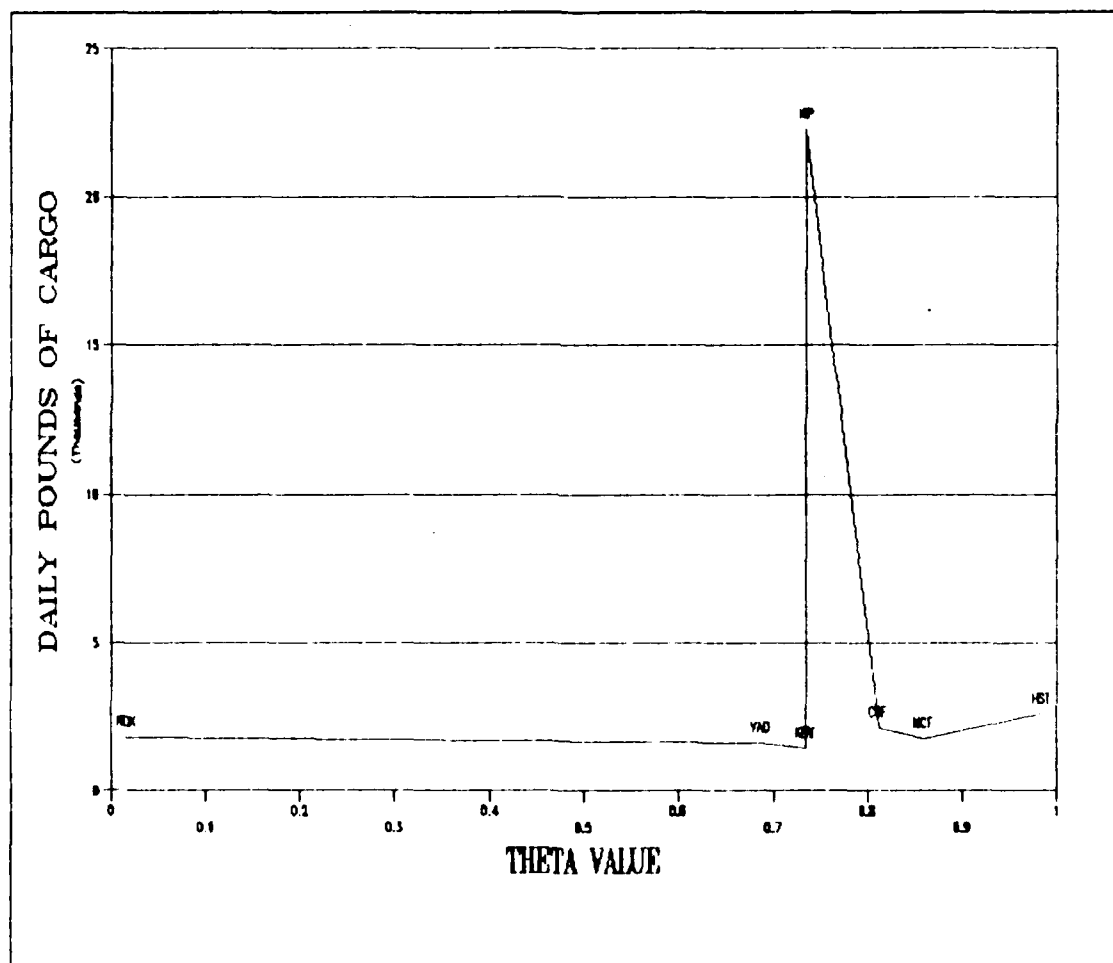


Figure 36: Spacefilling Curve Combined Route Model Jacksonville hub routing

7. Combined Route Model Norton Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	DMA	DAVIS-MONTHAM	32.10	110.53	0.00000	2,570
2	LSV	NELLIS	36.14	115.02	0.12500	2,946
3	NZJ	EL TORO	33.36	117.40	0.21875	548
4	SBD	NORTON (HUB)	34.06	117.14	0.21875	16,181
5	NTD	POINT MUGU	34.07	119.07	0.26563	3,592
6	LGB	LONG BEACH	33.45	118.14	0.26563	10,626
7	LUF	LUKE	33.32	112.23	0.96875	4,104

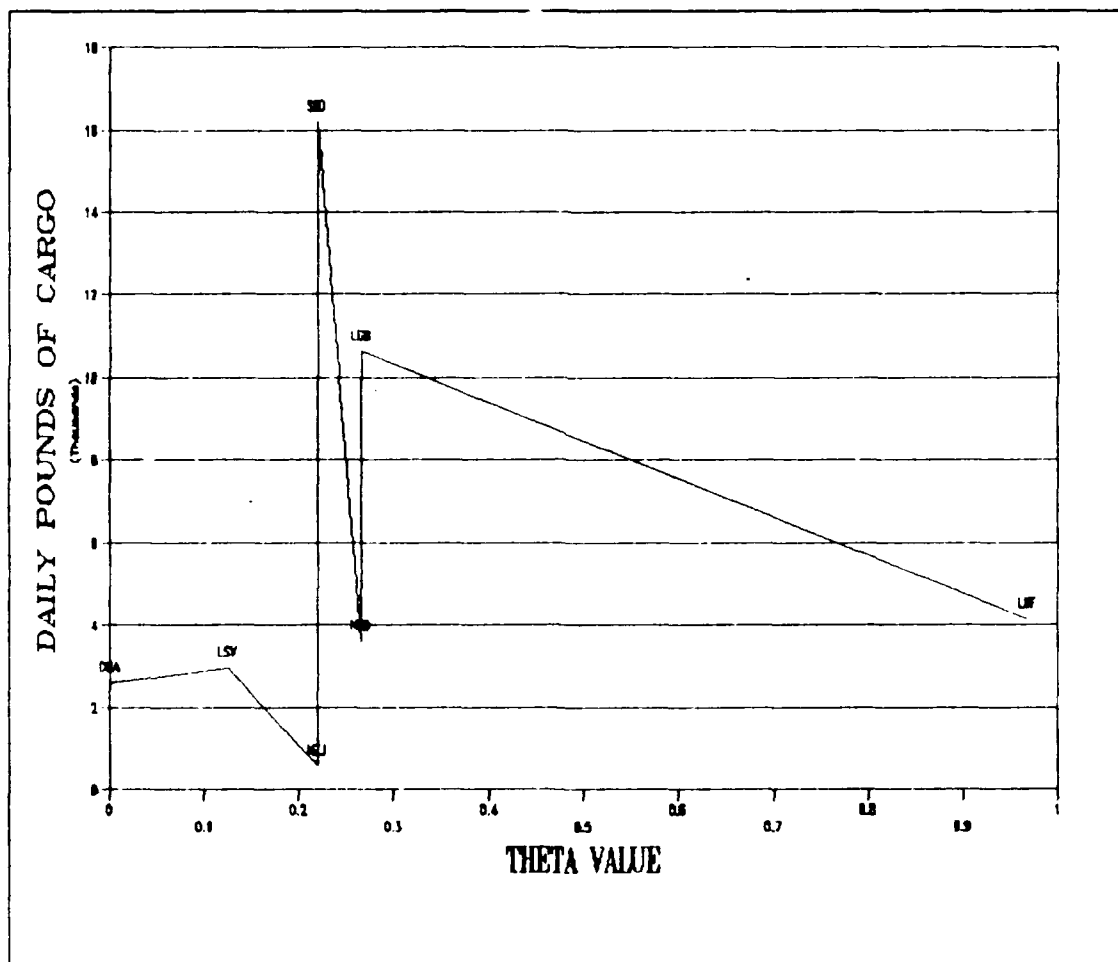


Figure 37: Spacefilling Curve Combined Route Model Norton hub routing

8. Combined Route Model Kelly Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	SKF	KELLY (HUB)	29.23	98.35	0.00000	31,959
2	HMN	HOLLOMAN	32.51	106.06	0.31250	3,421
3	CVS	CANNON	34.23	103.19	0.37500	1,521
4	ABQ	KIRTLAND	35.02	106.36	0.45313	927
5	DYS	DYESS	32.25	99.51	0.92188	2,564

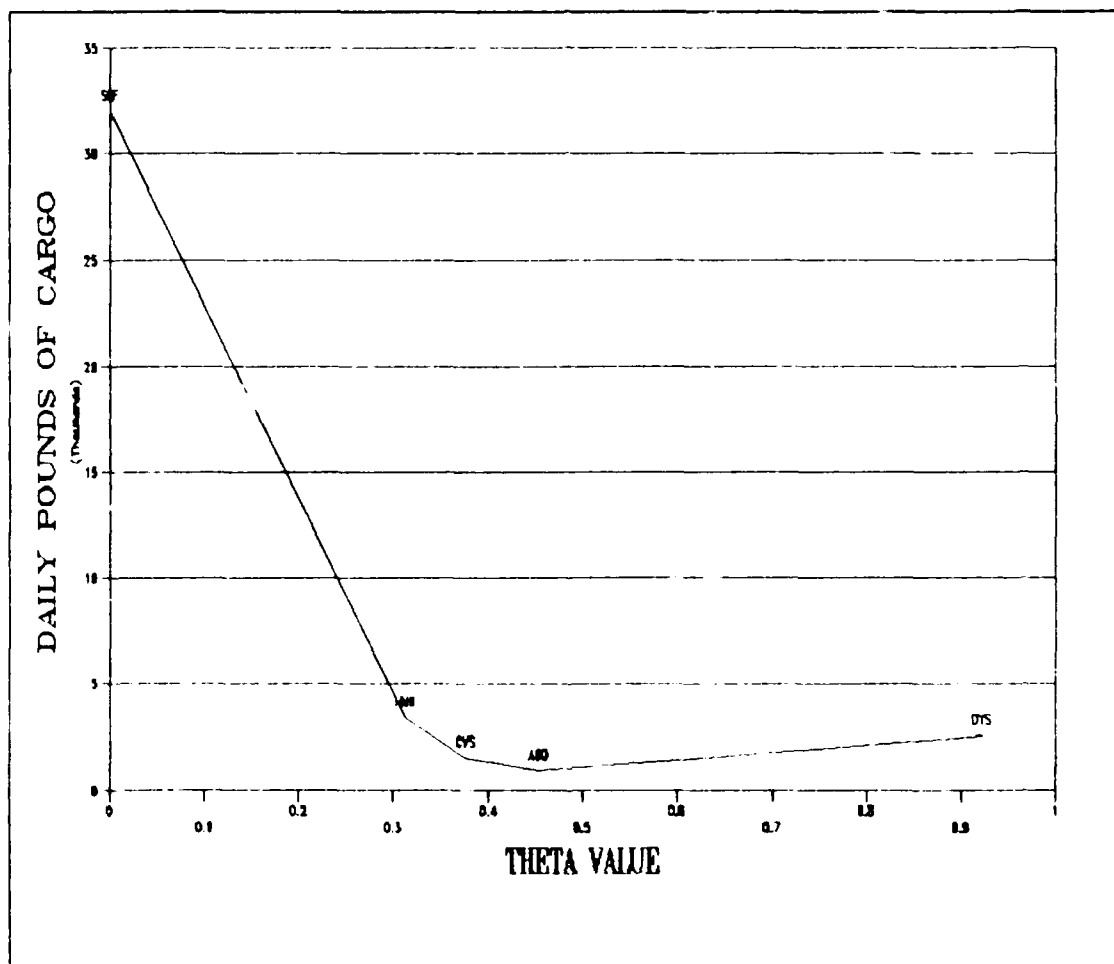


Figure 38: Spacefilling Curve Combined Route Model Kelly hub routing

9. Combined Route Model Travis Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	NLC	LEMOORE	36.15	119.57	0.00000	3,255
2	NGZ	OAKLAND	37.47	122.13	0.43750	4,223
3	SUU	TRAVIS AFB (HUB)	38.16	121.56	0.46875	50,150

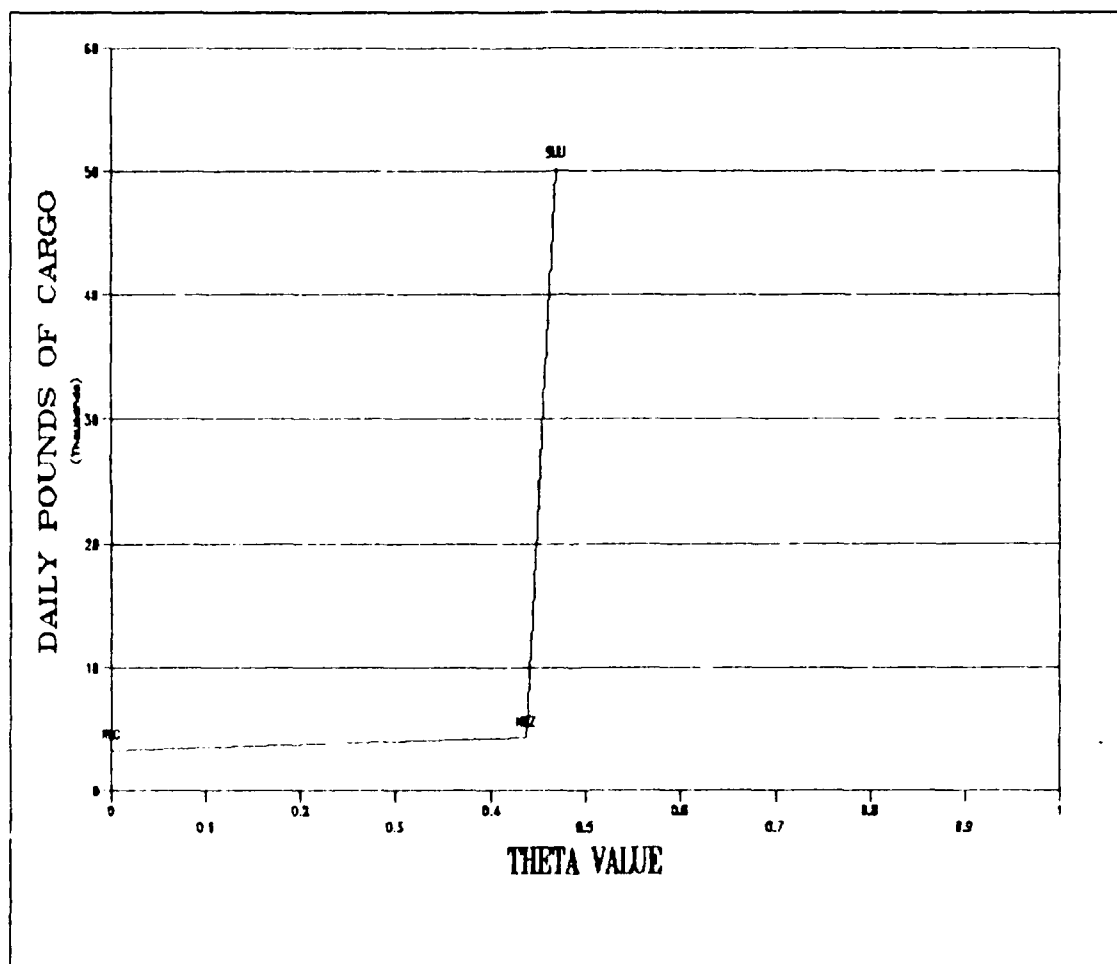


Figure 39: Spacefilling Curve Combined Route Model Travis hub routing

10. Combined Route Model McChord Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	SKA	FAIRCHILD	47.37	117.39	0.00000	1,844
2	PWT	BREMERTON	47.34	122.38	0.25000	5,510
3	TCM	MCCHORD (HUB)	47.08	122.28	0.25000	14,602
4	NUW	WHIDBEY ISLAND	48.17	122.37	0.26563	4,001

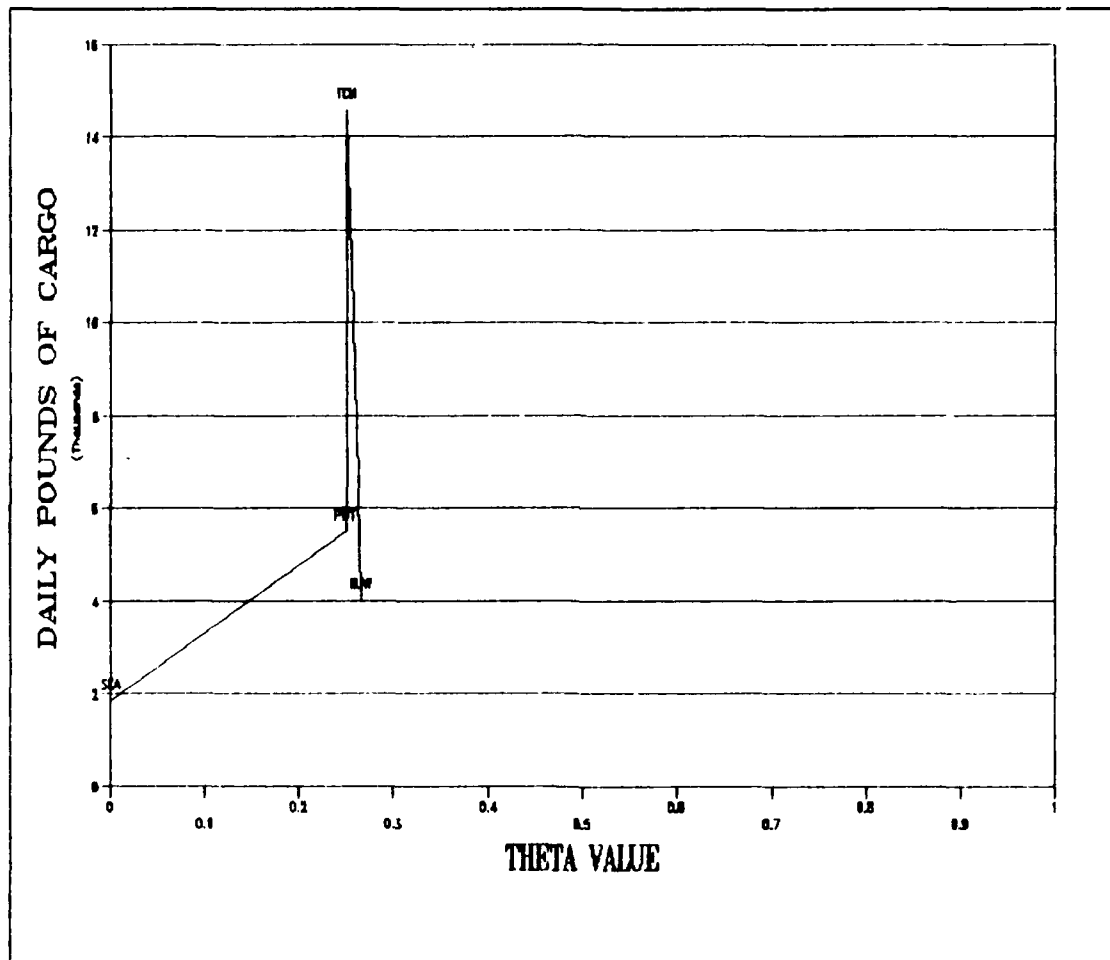


Figure 40: Spacefilling Curve Combined Route Model McChord hub routing

11. Combined Route Model Robins Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	PAM	TYNDALL	30.04	85.35	0.04688	1,939
2	VPS	EGLIN	30.29	86.32	0.06250	5,188
3	NPA	PENSOCOLA	30.21	87.19	0.18750	10,607
4	BIX	KEESLER	30.25	88.55	0.23438	1,452
5	CBM	COLUMBUS MS	33.39	88.26	0.42188	895
6	MEM	MEMPHIS	35.03	89.58	0.48438	599
7	BYH	IRA EAKER	35.58	89.57	0.50000	1,328
8	WRB	ROBINS (HUB)	32.38	83.35	0.95313	22,661

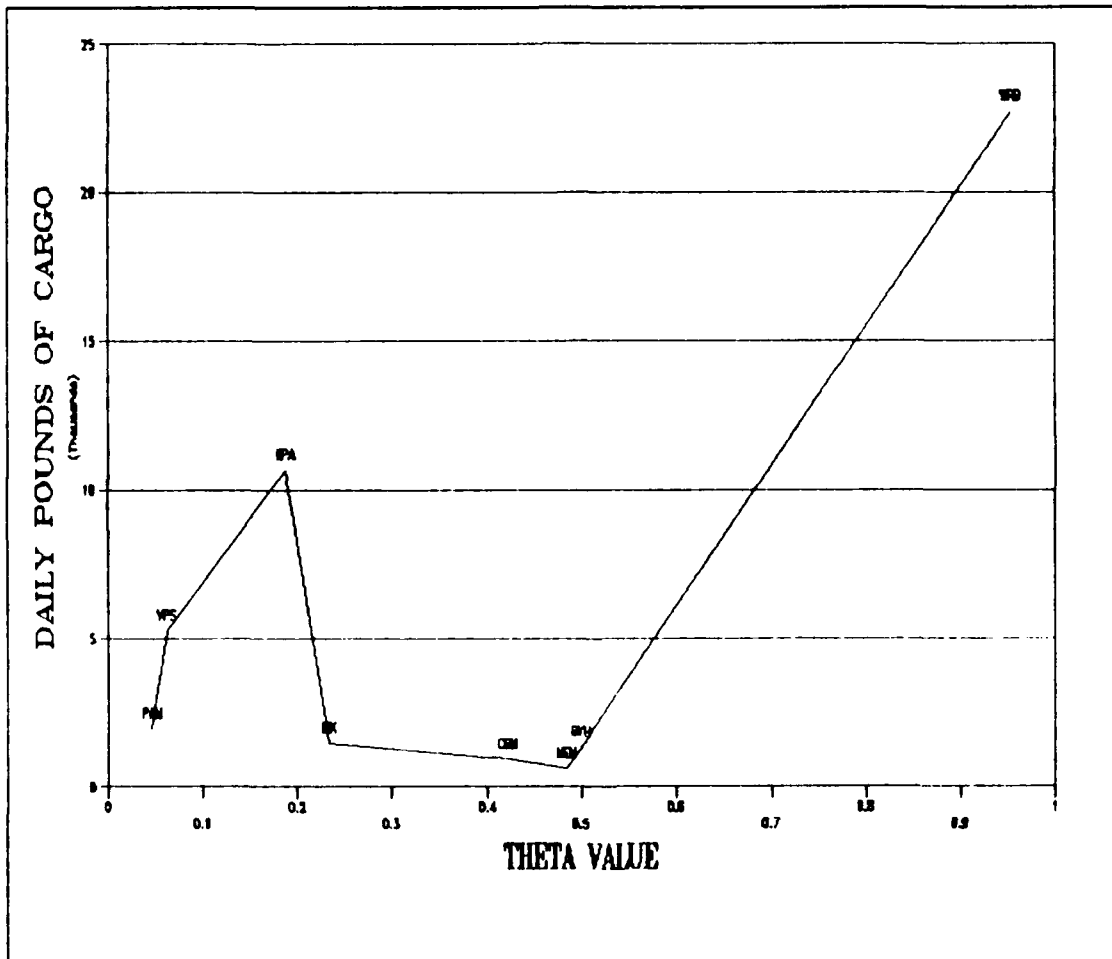


Figure 41: Spacefilling Curve Combined Route Model Robins hub routing

12. Combined Route Model McGuire Hub Routings

RANK	CODE	NAME	LAT	LONG	THETA	DAILY LBS
1	NCO	NEWPORT	41.28	71.20	0.07813	1,515
2	GON	NEW LONDON	41.21	72.07	0.17188	4,394
3	WRI	MCGUIRE (HUB)	40.01	74.35	0.25000	10,477
4	RME	GRIFFISS	43.14	75.24	0.31250	2,820
5	PBG	PLATTSBURGH	44.39	73.28	0.39063	3,108
6	LIZ	LORING	46.57	67.53	0.76563	2,007
7	PSM	PEASE	43.04	70.49	0.87500	3,574

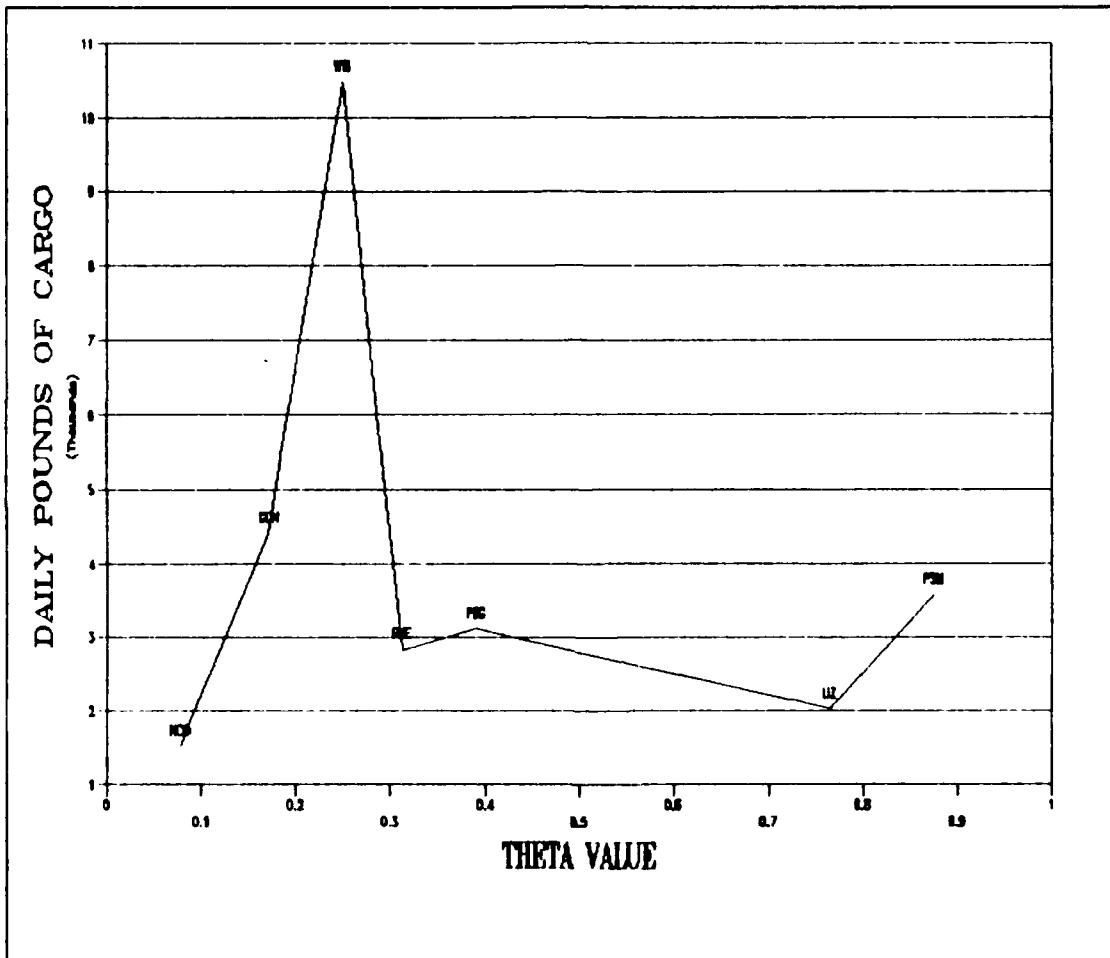


Figure 42: Spacefilling Curve Combined Route Model McGuire hub routing

Appendix J: Route Structures

Current LOGAIR Structure

Routes are for 6 day/week systems.

Route # & Orig	Dest	Vehicle & Mileage	# Stops	DO65 Tonnages
ROUTE 1		L100	4	35127
MCC	HIF	529		
HIF	TIK	884		
TIK	FFO	792		
FFO	WRB	496		
ROUTE 2		L100	5	35127
WRB	SSC	202		
SSC	LFI	316		
LFI	GSB	150		
GSB	CHS	208		
CHS	WRB	206		
ROUTE 3		L100	4	35127
WRB	SKF	917		
SKF	SBD	1143		
SBD	SUU	389		
SUU	MCC	40		
ROUTE 4		L100	5	35127
SUU	MCC	40		
MCC	HIF	529		
HIF	SKF	1106		
SKF	WRB	917		
WRB	FFO	496		
ROUTE 5		L100	3	35127
FFO	DOV	461		
DOV	WRI	77		
WRI	FFO	502		
ROUTE 6		L100	4	35127
FFO	TIK	792		
TIK	HIF	884		
HIF	MCC	529		
MCC	SUU	40		
ROUTE 7		L188	3	24549
HIF	SBD	564		
SBD	LSV	193		
LSV	HIF	376		
ROUTE 8		DC-9	2	16309
FFO	HIF	1468		
HIF	FFO	1468		
ROUT		DC-9	5	24464
FFO	PSM	721		
PSM	LIZ	304		

LIZ	PBG	313		
PBG	RME	138		
RME	FFO	506		
ROUTE 10		C640	5	11195
FFO	MTC	202		
MTC	OSC	131		
OSC	SAW	235		
SAW	DLH	231		
DLH	FFO	634		
ROUTE 10b		C640	4	2239
FFO	MTC	202		
MTC	OSC	131		
OSC	SAW	235		
SAW	FFO	481		
ROUTE 11		L188	5	24549
HIF	GFA	442		
GFA	MIB	460		
MIB	RCA	307		
RCA	FEW	224		
FEW	HIF	373		
ROUTE 12		DC-9	4	24464
SKF	HMN	506		
HMN	LUF	367		
LUF	DMA	129		
DMA	SKF	756		
ROUTE 13		L188	7	20457
WRB	NIP	201		
NIP	COF	152		
COF	HST	190		
HST	NQX	103		
NQX	MCF	231		
MCF	NIP	172		
NIP	WRB	201		
ROUTE 14		L188	4	4091
WRB	COF	352		
COF	HST	190		
HST	MCF	210		
MCF	JRB	336		
ROUTE 14b		L188	5	24549
WRB	VPS	228		
VPS	SKF	727		
SKF	BAD	363		
BAD	CBM	313		
CBM	WRB	290		
ROUTE 15		L188	2	24549
WRB	TIK	814		
TIK	HIF	884		
ROUTE 16		L188	4	24549
HIF	MUO	238		
MUO	TCM	431		
TCM	SKA	229		
SKA	HIF	529		
ROUTE 17		L188	2	24549

HIF	TIK	884		
TIK	WRB	814		
ROUTE 18		L188	6	24549
TIK	SZL	312		
SZL	OFF	207		
OFF	RDR	477		
RDR	RCA	379		
RCA	IAB	544		
IAB	TIK	153		
ROUTE 19		L188	4	24549
TIK	DYS	250		
DYS	SKF	223		
SKF	FWH	243		
FWH	TIK	182		
ROUTE 20		L188	6	24549
TIK	FFO	792		
FFO	BYH	418		
BYH	TIK	421		
TIK	SKF	421		
SKF	LRF	536		
LRF	TIK	299		
ROUTE 21		DC-9	3	24464
SKF	HIF	1106		
HIF	CVS	663		
CVS	SKF	443		
TRUCKS 1		MACK	2	24000
ABQ	CVS	193		
CVS	ABQ	193		
TRUCKS 2		MACK	2	24000
BAD	AEX	104		
AEX	BAD	104		
TRUCKS 3		MACK	2	24000
LRF	MEM	123		
MEM	LRF	123		
TRUCKS 4		MACK	2	24000
VPS	BIX	143		
BIX	VPS	143		
TRUCKS 5		MACK	2	24000
VPS	PAM	64		
PAM	VPS	64		
TRUCKS 6		MACK	2	24000
WRB	VAD	118		
VAD	WRB	118		
TRUCKS 7		MACK	2	24000
NKO	FFO	120		
FFO	NKO	120		
TRUCKS 8		MACK	2	24000
GUS	FFO	125		
FFO	GUS	125		
TOTAL MILEAGE:		43,873		
AIR MILEAGE:		41,893		
TRUCK MILEAGE:		1,980		

Author's LOGAIR Structure

Routes are for 6 day/week systems.

Route # & Orig	Dest	Vehicle & Mileage	# Stops	DO65 Tonnages
ROUTE 1		L100	3	35127
TIK	SBD	1131		
SBD	HIF	572		
HIF	TIK	875		
ROUTE 2		L100	3	35127
TIK	HIF	875		
HIF	MCC	545		
MCC	SUU	24		
ROUTE 3		L100	3	35127
TIK	HIF	875		
HIF	SBD	572		
SBD	TIK	1311		
ROUTE 4		L100	3	35127
SUU	MCC	40		
MCC	HIF	529		
HIF	TIK	875		
ROUTE 5		L100	4	35127
TIK	SKF	420		
SKF	WRB	196		
WRB	FFO	492		
FFO	TIK	780		
ROUTE 6		L100	4	35127
TIK	FFO	780		
FFO	WRB	492		
WRB	SKF	196		
SKF	TIK	420		
ROUTE 7		C640	5	13434
FFO	MTC	213		
MTC	OSC	137		
OSC	SAW	236		
SAW	DLH	233		
DLH	FFO	632		
ROUTE 8		L100	5	35127
FFO	RME	520		
RME	PBG	130		
PBG	LIZ	316		
LIZ	PSM	283		
PSM	FFO	743		
ROUTE 9		L100	4	35127
FFO	WRI	515		
WRI	DOV	81		
DOV	LFI	149		
LFI	FFO	455		
ROUTE 10		L188	4	25549
HIF	MUO	243		
MUO	TCM	432		

TCM	SKA	230		
SKA	HIF	520		
ROUTE 11		L188	6	34549
HIF	GFA	430		
GFA	MIB	463		
MIB	RDR	189		
RDR	RCA	369		
RCA	FEW	221		
FEW	HIF	367		
ROUTE 12		C640	4	13434
SBD	DMA	405		
DMA	LUF	130		
LUF	LSV	251		
LSV	SBD	187		
ROUTE 13		L188	5	24549
TIK	OFF	412		
OFF	SZL	216		
SZL	IAB	221		
IAB	LRF	343		
LRF	TIK	295		
ROUTE 14		L188	5	24549
WRB	BYH	419		
BYH	CBM	168		
CBM	BIX	217		
BIX	VPS	133		
VPS	WRB	227		
ROUTE 15		L188	4	24549
WRB	SSC	196		
SSC	GSB	190		
GSB	CHS	231		
CHS	WRB	194		
ROUTE 16		L100	7	35127
WRB	NIP	193		
NIP	COF	152		
COF	HST	197		
HST	NQX	99		
NQX	MCF	226		
MCF	NIP	190		
NIP	WRB	193		
TRUCKS 1		MACK	2	24000
FFO	NKO	123		
NKO	FFO	123		
TRUCKS 2		MACK	2	24000
FFO	GUS	151		
GUS	FFO	151		
TRUCKS 3		MACK	1	24000
HIF	ABQ	606		
TRUCKS 4		MACK	1	24000
ABQ	HIF	606		
TRUCKS 5		MACK	1	24000
SKF	HMN	611		
TRUCKS 6		MACK	1	24000
HMN	SKF	611		

TRUCKS 7		MACK	1	24000
SKF	DYS	263		
TRUCKS 8		MACK	1	24000
DYS	SKF	263		
TRUCKS 9		MACK	1	24000
AEX	SKF	461		
TRUCKS 10		MACK	1	24000
SKF	AEX	461		
TRUCKS 11		MACK	1	24000
TIK	CVS	414		
TRUCKS 12		MACK	1	24000
CVS	TIK	414		
TRUCKS 13		MACK	1	24000
TIK	FWH	231		
TRUCKS 14		MACK	1	24000
FWH	TIK	231		
TRUCKS 15		MACK	1	24000
TIK	BAD	359		
TRUCKS 16		MACK	1	24000
BAD	TIK	359		
TRUCKS 17		MACK	2	24000
WRB	VAD	150		
VAD	WRB	150		
TRUCKS 18		MACK	2	24000
BYH	MEM	46		
MEM	BYH	46		
TRUCKS 19		MACK	2	24000
VPS	PAM	72		
PAM	VPS	72		
TOTAL MILEAGE:		32,766		
AIR MILEAGE:		25,792		
TRUCK MILEAGE:		6,974		

Current QUICKTRANS Structure

Routes are for 6 day/week systems.

Route # & Orig	Dest	Vehicle & Mileage	# Stops	DO65 Tonnages
ROUTE 1		L100	2	29272
SUU	TCM	617		
TCM	SUU	617		
ROUTE 2		L100	3	11709
NGU	IND	577		
IND	NZY	1786		
NZY	SUU	468		
ROUTE 3		L100	5	29272
NGU	CHS	353		
CHS	NIP	184		
NIP	NPA	345		
NPA	NZY	1765		
NZY	SUU	468		
ROUTE 4		L100	5	29272
SUU	NZY	468		
NZY	NPA	1765		
NPA	NIP	345		
NIP	CHS	184		
CHS	NGU	353		
ROUTE 5		L100	5	11709
SUU	NZY	468		
NZY	IND	1786		
IND	NGU	577		
NGU	CHS	353		
CHS	NIP	184		
ROUTE 6		L100	2	11709
NIP	CHS	184		
CHS	NGU	353		
ROUT		L100	3	23418
NIP	COF	152		
COF	NQX	270		
NQX	NIP	400		
TRUCKS 1		MACK	1	24000
CHS	KBY	196		
TRUCKS 2		MACK	2	24000
NIP	NPA	414		
NPA	NIP	414		
TRUCKS 3		MACK	3	24000
NGU	DAG	146		
DAG	INH	8		
INH	NHK	52		
TRUCKS 3A		MACK	3	24000
NHK	INH	52		
INH	DAG	8		
DAG	NGU	146		
TRUCKS 4		MACK	4	24000

NGU	NHK	133		
NHK	DCA	56		
DCA	NHK	56		
NHK	NGU	133		
TRUCKS 5		MACK	2	24000
NGU	NKT	170		
NKT	NGU	170		
TRUCKS 6		MACK	2	24000
SUU	NFL	220		
NFL	SUU	220		
TRUCKS 7		MACK	2	24000
SUU	NFL	220		
NFL	SUU	220		
TRUCKS 8		MACK	2	24000
TCM	PWT	22		
PWT	TCM	22		
TRUCKS 9		MACK	1	24000
TCM	PWT	22		
TRUCKS 10		MACK	2	24000
TCM	NUW	90		
NUW	TCM	90		
TRUCKS 11		MACK	2	24000
NZY	SBD	136		
SBD	NZY	136		
TRUCKS 12		MACK	2	24000
SUU	NLC	212		
NLC	SUU	212		
TRUCKS 13		MACK	2	24000
NGZ	SUU	68		
SUU	NGZ	68		
TRUCKS 14		MACK	5	24000
NZY	LGB	111		
LGB	NTD	82		
NTD	LGB	82		
LGB	NZJ	52		
NZJ	NZY	80		
TRUCKS 15		MACK	5	24000
NZY	LGB	111		
LGB	SUU	452		
SUU	NGZ	68		
NGZ	LGB	428		
LGB	NZY	111		
TRUCKS 16		MACK	3	24000
NGU	DAG	146		
DAG	INH	8		
INH	NGU	154		
TRUCKS 17		MACK	4	24000
NGU	PNE	259		
PNE	PHL	10		
PHL	WRI	58		
WRI	NGU	308		
TRUCKS 18		MACK	3	24000
NGU	GON	467		

GON	NCO	54		
NCO	NGU	505		
TRUCKS 19				
	MACK		2	24000
NGU	TWH	7		
TWH	NGU	7		
TRUCKS 20				
	MACK		2	24000
NGU	TWH	7		
TWH	NGU	7		
TOTAL MILEAGE:		22,708		
AIR MILEAGE:		15,022		
TRUCK MILEAGE:		7,686		

Author's QUICKTRANS Structure

Routes are for 6 day/week systems.

Route # & Orig	Dest	Vehicle & Mileage	# Stops	DO65 Tonnages
ROUTE 1		L100	1	35127
NIP	NZY	2523		
ROUTE 2		L100	4	35127
NZY	SUU	468		
SUU	TCM	617		
TCM	SUU	617		
SUU	NZY	468		
ROUTE 3		L100	1	35127
NZY	NIP	2523		
ROUTE 4		L100	2	35127
NGU	CHS	354		
CHS	NIP	184		
ROUTE 5		L100	2	35127
NIP	CHS	184		
CHS	NGU	354		
ROUTE 6		L100	4	35127
NIP	COF	152		
COF	NQX	270		
NQX	NPA	538		
NPA	NIP	345		
TRUCKS 1		MACK	2	24000
SUU	NGZ	68		
NGZ	SUU	68		
TRUCKS 2		MACK	2	24000
SUU	NGZ	68		
NGZ	SUU	68		
TRUCKS 3		MACK	2	24000
NIP	KBY	28		
KBY	NIP	28		
TRUCKS 4		MACK	3	24000
TCM	PWT	22		
PWT	NUW	69		
NUW	TCM	90		
TRUCKS 5		MACK	1	24000
SUU	NLC	212		
TRUCKS 6		MACK	1	24000
NLC	SUU	212		
TRUCKS 7		MACK	1	24000
SUU	NFL	220		
TRUCKS 8		MACK	1	24000
NFL	SUU	220		
TRUCKS 9		MACK	3	24000
NZY	NZJ	80		
NZJ	SBD	60		
SBD	NZY	136		
TRUCKS 10		MACK	2	24000

NZY	LGB	111		
LGB	NTD	82		
TRUCKS 11		MACK	2	24000
NTD	LGB	82		
LGB	NZY	111		
TRUCKS 12		MACK	2	24000
NGU	TWH	7		
TWH	NGU	7		
TRUCKS 13		MACK	2	24000
NGU	GON	467		
GON	NCO	54		
TRUCKS 14		MACK	2	24000
GON	NCO	54		
NCO	NGU	467		
TRUCKS 15		MACK	1	24000
NGU	WRI	308		
TRUCKS 16		MACK	1	24000
WRI	NGU	308		
TRUCKS 17		MACK	1	24000
NGU	IND	692		
TRUCKS 18		MACK	1	24000
IND	NGU	692		
TRUCKS 19		MACK	3	24000
NGU	INH	154		
INH	DCA	17		
DCA	NGU	169		
TRUCKS 20		MACK	3	24000
NGU	DCA	169		
DCA	INH	17		
INH	NGU	154		
TRUCKS 21		MACK	3	24000
DAG	INH	8		
INH	DCA	17		
DCA	NGU	169		
TRUCKS 22		MACK	2	24000
NGU	NKT	170		
NKT	NGU	170		
TRUCKS 23		MACK	2	24000
NGU	PHL	259		
PHL	PNE	10		
TRUCKS 24		MACK	2	24000
PNE	PHL	10		
PHL	NGU	259		
TOTAL MILEAGE:		16,440		
AIR MILEAGE:		9,597		
TRUCK MILEAGE:		6,843		

Author's Combined LOGAIR/QUICKTRANS Structure

Routes are for 6 day/week systems.

Route # & Orig	Dest	Vehicle & Mileage	# Stops	DO65 Tonnages
ROUTE 1		L100	2	35127
TIK	FFO	780		
FFO	TIK	780		
ROUTE 2		L100	2	35127
FFO	TIK	780		
TIK	FFO	780		
ROUTE 3		L100	4	35127
FFO	WRI	515		
WRI	NGU	257		
NGU	WRB	500		
WRB	FFO	810		
ROUTE 4		L100	4	35127
FFO	WRB	810		
WRB	NGU	500		
NGU	WRI	257		
WRI	FFO	515		
ROUTE 5		L100	4	35127
WRB	NIP	193		
NIP	CHS	184		
CHS	NGU	353		
NGU	WRB	500		
ROUTE 6		L100	4	35127
WRB	NGU	500		
NGU	CHS	353		
CHS	NIP	184		
NIP	WRB	193		
ROUTE 7		L100	2	35127
TIK	WRB	819		
WRB	TIK	819		
ROUTE 8		L100	2	35127
WFB	TIK	819		
TIK	WRB	819		
ROUTE 9		L100	2	35127
TIK	SKF	420		
SKF	TIK	420		
ROUTE 10		L100	2	35127
TIK	SKF	420		
SKF	TIK	420		
ROUTE 11		L100	4	35127
HIF	TCM	672		
TCM	SUU	617		
SUU	MCC	24		
MCC	HIF	545		
ROUTE 12		L100	4	35127
HIF	MCC	545		
MCC	SUU	24		

SUU	TCM	617		
TCM	HIF	672		
ROUTE 13		L100	5	35127
HIF	NZY	671		
NZY	SBD	113		
SBD	SUU	375		
SUU	MCC	24		
MCC	HIF	545		
ROUTE 14		L100	5	35127
HIF	MCC	545		
MCC	SUU	24		
SUU	SBD	375		
SBD	NZY	113		
NZY	HIF	671		
ROUTE 15		L100	2	35127
TIK	HIF	1050		
HIF	TIK	1050		
ROUTE 16		L100	2	35127
TIK	HIF	1050		
HIF	TIK	1050		
ROUTE 17		L100	2	35127
TIK	HIF	1050		
HIF	TIK	1050		
ROUTE 18		L100	2	35127
TIK	HIF	1050		
HIF	TIK	1050		
ROUTE 19		C640	5	13434
FFO	MTC	213		
MTC	OSC	137		
OSC	SAW	236		
SAW	DLH	233		
DLH	FFO	632		
ROUTE 20		L188	6	24549
HIF	GFA	430		
GFA	MIB	463		
MIB	RDR	189		
RDR	RCA	369		
RCA	FEW	221		
FEW	HIF	367		
ROUTE 21		L100	5	35127
NIP	COF	152		
COF	MCF	127		
MCF	HST	200		
HST	NQX	99		
NQX	NIP	400		
ROUTE 22		C640	4	13434
SBD	LSV	187		
LSV	LUF	251		
LUF	DMA	130		
DMA	SBD	405		
ROUTE 23		C640	5	13434
SKF	DYS	219		
DYS	CVS	252		

CVS	ABQ	188		
ABQ	HMN	174		
HMN	SKF	509		
ROUTE 24		L100	5	35127
WRB	BYH	419		
BYH	CBM	168		
CBM	NPA	228		
NPA	VPS	52		
VPS	WRB	227		
ROUTE 25		L188	5	24549
WRI	PSM	289		
PSM	LIZ	283		
LIZ	PBG	316		
PBG	RME	130		
RME	WRI	221		
ROUTE 26		L100	3	35127
WRB	NGU	500		
NGU	FFO	472		
FFO	WRB	492		
ROUTE 27		L100	3	35127
WRB	NGU	500		
NGU	FFO	472		
FFO	WRB	492		
TRUCKS 1		MACK	2	24000
DOV	WRI	97		
WRI	DOV	97		
TRUCKS 2		MACK	2	24000
DOV	WRI	97		
WRI	DOV	97		
TRUCKS 3		MACK	2	24000
SBD	LGB	85		
LGB	SBD	85		
TRUCKS 4		MACK	2	24000
NZY	LGB	111		
LGB	NZY	111		
TRUCKS 5		MACK	4	24000
DOV	NHK	98		
NHK	DAG	51		
DAG	INH	8		
INH	DOV	130		
TRUCKS 6		MACK	3	24000
DOV	PHL	43		
PHL	PNE	10		
PNE	DOV	43		
TRUCKS 7		MACK	3	24000
FFO	IND	136		
IND	GUS	80		
GUS	FFO	151		
TRUCKS 8		MACK	2	24000
FFO	NKO	123		
NKO	FFO	123		
TRUCKS 9		MACK	1	24000
HIF	MUO	291		

TRUCKS 10		MACK	1	24000
MUO	HIF	291		
TRUCKS 11		MACK	2	24000
NGU	NKT	170		
NKT	NGU	170		
TRUCKS 12		MACK	2	24000
NGU	GSB	147		
GSB	NGU	147		
TRUCKS 13		MACK	6	24000
NGU	LFI	40		
LFI	TWH	46		
TWH	NGU	7		
NGU	LFI	40		
LFI	TWH	46		
TWH	NGU	7		
TRUCKS 14		MACK	3	24000
NIP	KBY	28		
KBY	VAD	123		
VAD	NIP	128		
TRUCKS 15		MACK	3	24000
SBD	LGB	85		
LGB	NZJ	52		
NZJ	SBD	61		
TRUCKS 16		MACK	3	24000
SBD	NTD	132		
NTD	LGB	82		
LGB	SBD	85		
TRUCKS 17		MACK	2	24000
SUU	NGZ	68		
NGZ	SUU	68		
TRUCKS 18		MACK	1	24000
SUU	NLC	212		
TRUCKS 19		MACK	1	24000
NLC	SUU	212		
TRUCKS 20		MACK	1	24000
TCM	SKA	276		
TRUCKS 21		MACK	1	24000
SKA	TCM	276		
TRUCKS 22		MACK	3	24000
TCM	PWT	22		
PWT	NUW	69		
NUW	TCM	90		
TRUCKS 23		MACK	2	24000
BYH	MEM	46		
MEM	BYH	46		
TRUCKS 24		MACK	2	24000
VPS	PAM	72		
PAM	VPS	72		
TRUCKS 25		MACK	2	24000
NPA	BIX	97		
BIX	NPA	97		
TRUCKS 26		MACK	2	24000
WRI	GON	174		

GON	NCO	54		
TRUCKS	27	MACK	2	24000
NCO	GON	54		
GON	WRI	174		

TOTAL MILEAGE:	48,449
AIR MILEAGE:	42,316
TRUCK MILEAGE:	6,133

Appendix K:
Extracts of the Inter-Locational Cargo Demand Files

QUICKTRANS File (Interpolated from FY 89 Data)

File used by the D065 model to evaluate route structures.
Cargo tons are for FY 89. List represents only a small
portion of the entire inter-locational cargo demand file.

FY	FROM	TO	TONS	N/A	TONS
F89	CHS	COF	14.1	0.0	14.1
F89	CHS	DAG	14.2	0.0	14.2
F89	CHS	DCA	47.0	0.0	47.0
F89	CHS	GON	57.0	0.0	57.0
F89	CHS	IND	53.6	0.0	53.6
F89	CHS	INH	14.2	0.0	14.2
F89	CHS	KBY	18.3	0.0	18.3
F89	CHS	LGB	137.8	0.0	137.8
F89	CHS	NCO	19.6	0.0	19.6
F89	CHS	NFL	17.2	0.0	17.2
F89	CHS	NGU	692.5	0.0	692.5
F89	CHS	NGZ	54.8	0.0	54.8
F89	CHS	NHK	60.3	0.0	60.3
F89	CHS	NIP	266.5	0.0	266.5
F89	CHS	NKT	127.9	0.0	127.9
F89	CHS	NLC	42.2	0.0	42.2
F89	CHS	NPA	137.6	0.0	137.6
F89	CHS	NQX	21.7	0.0	21.7
F89	CHS	NTD	46.6	0.0	46.6
F89	CHS	NUW	51.9	0.0	51.9
F89	CHS	NZJ	7.1	0.0	7.1
F89	CHS	NZY	519.8	0.0	519.8
F89	CHS	PHL	46.2	0.0	46.2
F89	CHS	PNE	3.5	0.0	3.5
F89	CHS	PWT	71.5	0.0	71.5
F89	CHS	SBD	41.6	0.0	41.6
F89	CHS	SUU	500.7	0.0	500.7
F89	CHS	TCM	93.4	0.0	93.4
F89	CHS	TWH	15.2	0.0	15.2
F89	CHS	WRI	25.8	0.0	25.8
F89	COF	CHS	13.3	0.0	13.3
F89	COF	DAG	0.8	0.0	0.8
F89	COF	DCA	2.7	0.0	2.7
F89	COF	GON	3.3	0.0	3.3
F89	COF	IND	3.1	0.0	3.1
F89	COF	INH	0.8	0.0	0.8
F89	COF	KBY	1.1	0.0	1.1
F89	COF	LGB	8.0	0.0	8.0
F89	COF	NCO	1.1	0.0	1.1

LOGAIR File FY 89 Data

File used by the DO65 model to evaluate route structures.
Cargo tons are for FY 89. List represents only a small
portion of the entire inter-locational cargo demand file.

FY	FROM	TO	TONS	N/A	TONS
F89	ABQ	BAD	1.6	0.0	1.6
F89	ABQ	BIX	0.4	0.0	0.4
F89	ABQ	BYH	0.1	0.0	0.1
F89	ABQ	CBM	0.4	0.0	0.4
F89	ABQ	CHS	0.2	0.0	0.2
F89	ABQ	COF	3.2	0.0	3.2
F89	ABQ	CVS	0.2	0.0	0.2
F89	ABQ	DMA	1.9	0.0	1.9
F89	ABQ	DOV	1.5	0.0	1.5
F89	ABQ	DYS	2.5	0.0	2.5
F89	ABQ	FEW	1.0	0.0	1.0
F89	ABQ	FFO	4.1	0.0	4.1
F89	ABQ	FWH	0.5	0.0	0.5
F89	ABQ	GFA	2.6	0.0	2.6
F89	ABQ	GSB	2.9	0.0	2.9
F89	ABQ	HIF	8.4	0.0	8.4
F89	ABQ	HMN	0.3	0.0	0.3
F89	ABQ	HST	1.7	0.0	1.7
F89	ABQ	IAB	0.5	0.0	0.5
F89	ABQ	LFI	0.6	0.0	0.6
F89	ABQ	LRF	1.0	0.0	1.0
F89	ABQ	LSV	2.6	0.0	2.6
F89	ABQ	LUF	2.1	0.0	2.1
F89	ABQ	MCC	4.8	0.0	4.8
F89	ABQ	MCF	0.3	0.0	0.3
F89	ABQ	MIB	0.8	0.0	0.8
F89	ABQ	MTC	0.4	0.0	0.4
F89	ABQ	MUO	0.8	0.0	0.8
F89	ABQ	NIP	6.5	0.0	6.5
F89	ABQ	NQX	0.2	0.0	0.2
F89	ABQ	OFF	0.0	0.0	0.0
F89	ABQ	OSC	0.0	0.0	0.0
F89	ABQ	PAM	0.0	0.0	0.0
F89	ABQ	PBG	0.2	0.0	0.2
F89	ABQ	PSM	0.7	0.0	0.7
F89	ABQ	RCA	0.4	0.0	0.4
F89	ABQ	RDR	0.3	0.0	0.3
F89	ABQ	RME	0.6	0.0	0.6
F89	ABQ	SBD	9.4	0.0	9.4
F89	ABQ	SKA	0.5	0.0	0.5
F89	ABQ	SKF	10.0	0.0	10.0
F89	ABQ	SSC	0.3	0.0	0.3
F89	ABQ	SUU	6.5	0.0	6.5
F89	ABQ	SZL	0.6	0.0	0.6

Appendix L: D065 Evaluation of QUICKTRANS Routes

D065 Results of Current QUICKTRANS Route

The following represents only extracts of the actual LOGISTICS AIR LIFT COMPUTER MODEL REPORT commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 64.40 percent of total demand of 480455. pounds
unsatisfied total - 171058. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-TCM	617.	29272.	15835.62	54.
TCM-SUU	617.	29272.	14142.47	48.

TOTAL DISTANCE = 1234.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36121650.

ACTUAL LOAD = (DIST.)(LOAD) = 18496480.

ROUTE UTILIZATION = 51.

ROUTE 2 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-IND	577.	11709.	11709.00	100.
IND-NZY	1786.	11709.	10185.71	87.
NZY-SUU	468.	11709.	11709.00	100.

TOTAL DISTANCE = 2831.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 33148180.

ACTUAL LOAD = (DIST.)(LOAD) = 30427590.

ROUTE UTILIZATION = 92.

ROUTE 3 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-CHS	353.	29272.	29272.00	100.
CHS-NIP	184.	29272.	29272.00	100.
NIP-NPA	345.	29272.	29272.00	100.
NPA-NZY	1765.	29272.	29272.00	100.
NZY-SUU	468.	29272.	19573.78	67.

TOTAL DISTANCE = 3115.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 91182280.

ACTUAL LOAD = (DIST.)(LOAD) = 86643510.

ROUTE UTILIZATION = 95.

ROUTE 4 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NZY	468.	29272.	19468.49	67.
NZY-NPA	1765.	29272.	29272.00	100.
NPA-NIP	345.	29272.	29272.00	100.
NIP-CHS	184.	29272.	26690.41	91.
CHS-NGU	353.	29272.	23502.73	80.

TOTAL DISTANCE = 3115.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 91182280.

ACTUAL LOAD = (DIST.)(LOAD) = 84082670.

ROUTE UTILIZATION = 92.

ROUTE 5 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NZY	468.	11709.	4821.92	41.
NZY-IND	1786.	11709.	10026.81	86.
IND-NGU	577.	11709.	11709.00	100.
NGU-CHS	353.	11709.	11709.00	100.
CHS-NIP	184.	11709.	10734.25	92.

TOTAL DISTANCE = 3368.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 39435910.

ACTUAL LOAD = (DIST.)(LOAD) = 33029010.

ROUTE UTILIZATION = 84.

ROUTE 6 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-CHS	184.	11709.	10641.86	91.
CHS-NGU	353.	11709.	11709.00	100.

TOTAL DISTANCE = 537.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6287733.

ACTUAL LOAD = (DIST.)(LOAD) = 6091380.

ROUTE UTILIZATION = 97.

ROUTE 7 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-COF	152.	23418.	12536.99	54.
COF-NQX	270.	23418.	10158.90	43.
NQX-NIP	400.	23418.	11019.18	47.

TOTAL DISTANCE = 822.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19249600.

ACTUAL LOAD = (DIST.)(LOAD) = 9056198.

ROUTE UTILIZATION = 47.

TRUCKS 1 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
CHS-KBY	196.	24000.	6695.88	28.

TOTAL DISTANCE = 196.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4704000.

ACTUAL LOAD = (DIST.)(LOAD) = 1312393.

ROUTE UTILIZATION = 28.

TRUCKS 2 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-NPA	414.	24000.	2767.13	12.
NPA-NIP	414.	24000.	2241.10	9.

TOTAL DISTANCE = 828.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19872000.

ACTUAL LOAD = (DIST.)(LOAD) = 2073404.

ROUTE UTILIZATION = 10.

TRUCKS 3 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-DAG	146.	24000.	3747.95	16.
DAG-INH	8.	24000.	2926.03	12.
INH-NHK	52.	24000.	1369.86	6.

TOTAL DISTANCE = 206.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4944000.

ACTUAL LOAD = (DIST.)(LOAD) = 641841.

ROUTE UTILIZATION = 13.

TRUCKS 3a MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NHK-INH	52.	24000.	1589.04	7.
INH-DAG	8.	24000.	1232.88	5.
DAG-NGU	146.	24000.	3589.04	15.

TOTAL DISTANCE = 206.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4944000.

ACTUAL LOAD = (DIST.)(LOAD) = 616493.

ROUTE UTILIZATION = 12.

TRUCKS 4 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-NHK	133.	24000.	11002.74	46.
NHK-DCA	56.	24000.	5989.04	25.
DCA-NHK	56.	24000.	7090.41	30.
NHK-NGU	133.	24000.	12350.69	51.

TOTAL DISTANCE = 378.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9072000.

ACTUAL LOAD = (DIST.)(LOAD) = 3838455.

ROUTE UTILIZATION = 42.

TRUCKS 5 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-NKT	170.	24000.	9841.10	41.
NKT-NGU	170.	24000.	10032.88	42.

TOTAL DISTANCE = 340.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8160000.

ACTUAL LOAD = (DIST.)(LOAD) = 3378576.

ROUTE UTILIZATION = 41.

TRUCKS 6 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NFL	220.	24000.	1610.96	7.
NFL-SUU	220.	24000.	4641.10	19.

TOTAL DISTANCE = 440.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 10560000.

ACTUAL LOAD = (DIST.)(LOAD) = 1375453.

ROUTE UTILIZATION = 13.

TRUCKS 7 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NFL	220.	24000.	1846.57	8.
NFL-SUU	220.	24000.	.00	0.

TOTAL DISTANCE = 440.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 10560000.

ACTUAL LOAD = (DIST.)(LOAD) = 406246.

ROUTE UTILIZATION = 4.

TRUCKS 8 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TCM-PWT	22.	24000.	4213.70	18.
PWT-TCM	22.	24000.	4887.67	20.

TOTAL DISTANCE = 44.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 1056000.

ACTUAL LOAD = (DIST.)(LOAD) = 200230.

ROUTE UTILIZATION = 19.

TRUCKS 9 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TCM-PWT	22.	24000.	2142.47	9.

TOTAL DISTANCE = 22.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 528000.

ACTUAL LOAD = (DIST.)(LOAD) = 47134.

ROUTE UTILIZATION = 9.

TRUCKS 10 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TCM-NUW	90.	24000.	4904.11	20.
NUW-TCM	90.	24000.	5013.70	21.

TOTAL DISTANCE = 180.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4320000.

ACTUAL LOAD = (DIST.)(LOAD) = 892603.

ROUTE UTILIZATION = 21.

TRUCKS 11 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-SBD	136.	24000.	5917.81	25.
SBD-NZY	136.	24000.	5545.21	23.

TOTAL DISTANCE = 272.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6528000.

ACTUAL LOAD = (DIST.)(LOAD) = 1558970.

ROUTE UTILIZATION = 24.

TRUCKS 12 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NLC	212.	24000.	4832.88	20.
NLC-SUU	212.	24000.	3336.99	14.

TOTAL DISTANCE = 424.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 10176000.

ACTUAL LOAD = (DIST.)(LOAD) = 1732011.

ROUTE UTILIZATION = 17.

TRUCKS 13 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGZ-SUU	68.	24000.	4728.77	20.
SUU-NGZ	68.	24000.	7534.84	31.

TOTAL DISTANCE = 136.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 3264000.

ACTUAL LOAD = (DIST.)(LOAD) = 833925.

ROUTE UTILIZATION = 26.

TRUCKS 14 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-LGB	111.	24000.	6027.40	25.
LGB-NTD	82.	24000.	5430.14	23.
NTD-LGB	82.	24000.	5238.36	22.
LGB-NZJ	52.	24000.	3704.11	15.
NZJ-NZY	80.	24000.	4328.77	18.

TOTAL DISTANCE = 407.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9768000.

ACTUAL LOAD = (DIST.)(LOAD) = 2082773.

ROUTE UTILIZATION = 21.

TRUCKS 15 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-LGB	111.	24000.	4624.66	19.
LGB-SUU	452.	24000.	6471.23	27.
SUU-NGZ	68.	24000.	6060.27	25.
NGZ-LGB	428.	24000.	8345.21	35.
LGB-NZY	111.	24000.	9358.90	39.

TOTAL DISTANCE = 1170.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 28080000.

ACTUAL LOAD = (DIST.)(LOAD) = 8461019.

ROUTE UTILIZATION = 30.

TRUCKS 16 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-DAG	146.	24000.	4854.79	20.
DAG-INH	8.	24000.	2498.63	10.
INH-NGU	154.	24000.	3589.04	15.

TOTAL DISTANCE = 308.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 7392000.

ACTUAL LOAD = (DIST.)(LOAD) = 1281502.

ROUTE UTILIZATION = 17.

TRUCKS 17 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-PNE	259.	24000.	14931.51	62.
PNE-PHL	10.	24000.	15786.30	66.
PHL-WRI	58.	24000.	16783.56	70.
WRI-NGU	308.	24000.	17189.04	72.

TOTAL DISTANCE = 635.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 15240000.

ACTUAL LOAD = (DIST.)(LOAD) = 10292800.

ROUTE UTILIZATION = 68.

TRUCKS 18 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-GON	467.	24000.	11123.29	46.
GON-NCO	54.	24000.	10794.52	45.
NCO-NGU	505.	24000.	11375.34	47.

TOTAL DISTANCE = 1026.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 24624000.

ACTUAL LOAD = (DIST.)(LOAD) = 11522030.

ROUTE UTILIZATION = 47.

TRUCKS 19 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-TWH	7.	24000.	2920.55	12.
TWH-NGU	7.	24000.	5786.30	24.

TOTAL DISTANCE = 14.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 336000.

ACTUAL LOAD = (DIST.)(LOAD) = 60948.

ROUTE UTILIZATION = 18.

TRUCKS 20 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-TWH	7.	24000.	2991.78	12.
TWH-NGU	7.	24000.	.00	0.

TOTAL DISTANCE = 14.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 336000.

ACTUAL LOAD = (DIST.)(LOAD) = 20942.

ROUTE UTILIZATION = 6.

D065 Results of Author's QUICKTRANS Route Model

The following represents only extracts of the actual LOGISTICS AIR LIFT COMPUTER MODEL REPORT commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 58.54 percent of total demand of 480455. pounds
unsatisfied total - 199180. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-NZY	2523.	35127.	31170.84	89.

TOTAL DISTANCE = 2523.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 88625420.

ACTUAL LOAD = (DIST.)(LOAD) = 78644020.

ROUTE UTILIZATION = 89.

ROUTE 2 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-SUU	468.	35127.	35127.00	100.
SUU-TCM	617.	35127.	16666.72	47.
TCM-SUU	617.	35127.	16602.74	47.
SUU-NZY	468.	35127.	35127.00	100.

TOTAL DISTANCE = 2170.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 76225590.

ACTUAL LOAD = (DIST.)(LOAD) = 53406130.

ROUTE UTILIZATION = 70.

ROUTE 3 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-NIP	2523.	35127.	34818.39	99.

TOTAL DISTANCE = 2523.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 88625420.

ACTUAL LOAD = (DIST.)(LOAD) = 87846790.

ROUTE UTILIZATION = 99.

ROUTE 4 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-CHS	354.	35127.	35127.00	100.
CHS-NIP	184.	35127.	35127.00	100.

TOTAL DISTANCE = 538.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 18898330.

ACTUAL LOAD = (DIST.)(LOAD) = 18898330.

ROUTE UTILIZATION = 100.

ROUTE 5 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-CHS	184.	35127.	35127.00	100.
CHS-NGU	354.	35127.	34644.81	99.

TOTAL DISTANCE = 538.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 18898330.

ACTUAL LOAD = (DIST.)(LOAD) = 18727630.

ROUTE UTILIZATION = 99.

ROUTE 6 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-COF	152.	35127.	26610.17	76.
COF-NQX	270.	35127.	23574.55	67.
NQX-NPA	538.	35127.	22522.50	64.
NPA-NIP	345.	35127.	25822.89	74.

TOTAL DISTANCE = 1305.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 45840740.

ACTUAL LOAD = (DIST.)(LOAD) = 31435870.

ROUTE UTILIZATION = 69.

TRUCKS 1 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NGZ	68.	24000.	4295.89	18.
NGZ-SUU	68.	24000.	6043.84	25.

TOTAL DISTANCE = 136.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 3264000.

ACTUAL LOAD = (DIST.)(LOAD) = 703101.

ROUTE UTILIZATION = 22.

TRUCKS 2 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NGZ	68.	24000.	1769.86	7.
NGZ-SUU	68.	24000.	.00	0.

TOTAL DISTANCE = 136.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 3264000.

ACTUAL LOAD = (DIST.)(LOAD) = 120351.

ROUTE UTILIZATION = 4.

TRUCKS 3 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NIP-KBY	28.	24000.	8471.23	35.
KBY-NIP	28.	24000.	7128.77	30.

TOTAL DISTANCE = 56.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 1344000.

ACTUAL LOAD = (DIST.)(LOAD) = 436800.

ROUTE UTILIZATION = 32.

TRUCKS 4 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TCM-PWT	22.	24000.	11747.94	49.
PWT-NUW	69.	24000.	11265.75	47.
NUW-TCM	90.	24000.	11101.37	46.

TOTAL DISTANCE = 181.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4344000.

ACTUAL LOAD = (DIST.)(LOAD) = 2034915.

ROUTE UTILIZATION = 47.

TRUCKS 5 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NLC	212.	24000.	4690.41	20.

TOTAL DISTANCE = 212.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5088000.

ACTUAL LOAD = (DIST.)(LOAD) = 994367.

ROUTE UTILIZATION = 20.

TRUCKS 6 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NLC-SUU	212.	24000.	4273.97	18.

TOTAL DISTANCE = 212.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5088000.

ACTUAL LOAD = (DIST.)(LOAD) = 906082.

ROUTE UTILIZATION = 18.

TRUCKS 7 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-NFL	220.	24000.	3172.60	13.

TOTAL DISTANCE = 220.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5280000.

ACTUAL LOAD = (DIST.)(LOAD) = 697973.

ROUTE UTILIZATION = 13.

TRUCKS 8 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NFL-SUU	220.	24000.	4745.21	20.

TOTAL DISTANCE = 220.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5280000.

ACTUAL LOAD = (DIST.)(LOAD) = 1043945.

ROUTE UTILIZATION = 20.

TRUCKS 9 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-NZJ	80.	24000.	9808.22	41.
NZJ-SBD	60.	24000.	9939.72	41.
SBD-NZY	136.	24000.	9665.75	40.

TOTAL DISTANCE = 276.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6624000.

ACTUAL LOAD = (DIST.)(LOAD) = 2695584.

ROUTE UTILIZATION = 41.

TRUCKS 10 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NZY-LGB	111.	24000.	15819.18	66.
LGB-NTD	82.	24000.	5830.14	24.

TOTAL DISTANCE = 193.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4632000.

ACTUAL LOAD = (DIST.)(LOAD) = 2234001.

ROUTE UTILIZATION = 48.

TRUCKS 11 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NTD-LGB	82.	24000.	5441.10	23.
LGB-NZY	111.	24000.	16000.00	67.

TOTAL DISTANCE = 193.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4632000.

ACTUAL LOAD = (DIST.)(LOAD) = 2222170.

ROUTE UTILIZATION = 48.

TRUCKS 12 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-TWH	7.	24000.	5517.81	23.
TWH-NGU	7.	24000.	4838.36	20.

TOTAL DISTANCE = 14.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 336000.

ACTUAL LOAD = (DIST.)(LOAD) = 72493.

ROUTE UTILIZATION = 22.

TRUCKS 13 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-GON	467.	24000.	10832.88	45.
GON-NCO	54.	24000.	9238.36	38.

TOTAL DISTANCE = 521.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 12504000.

ACTUAL LOAD = (DIST.)(LOAD) = 5557824.

ROUTE UTILIZATION = 44.

TRUCKS 14 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
GON-NCO	54.	24000.	449.31	2.
NCO-NGU	467.	24000.	9589.04	40.

TOTAL DISTANCE = 521.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 12504000.

ACTUAL LOAD = (DIST.)(LOAD) = 4502345.

ROUTE UTILIZATION = 36.

TRUCKS 15 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-WRI	308.	24000.	5304.11	22.

TOTAL DISTANCE = 308.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 7392000.

ACTUAL LOAD = (DIST.)(LOAD) = 1633665.

ROUTE UTILIZATION = 22.

TRUCKS 16 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRI-NGU	308.	24000.	4580.82	19.

TOTAL DISTANCE = 308.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 7392000.

ACTUAL LOAD = (DIST.)(LOAD) = 1410893.

ROUTE UTILIZATION = 19.

TRUCKS 17 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-IND	692.	24000.	6438.35	27.

TOTAL DISTANCE = 692.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 16608000.

ACTUAL LOAD = (DIST.)(LOAD) = 4455340.

ROUTE UTILIZATION = 27.

TRUCKS 18 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
IND-NGU	692.	24000.	5419.18	23.

TOTAL DISTANCE = 692.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 16608000.

ACTUAL LOAD = (DIST.)(LOAD) = 3750071.

ROUTE UTILIZATION = 23.

TRUCKS 19 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-INH	154.	24000.	4361.64	18.
INH-DCA	17.	24000.	789.04	3.
DCA-NGU	169.	24000.	5747.95	24.

TOTAL DISTANCE = 340.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8160000.

ACTUAL LOAD = (DIST.)(LOAD) = 1656510.

ROUTE UTILIZATION = 20.

TRUCKS 20 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-DCA	169.	24000.	4991.78	21.
DCA-INH	17.	24000.	449.31	2.
INH-NGU	154.	24000.	7178.08	30.

TOTAL DISTANCE = 340.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8160000.

ACTUAL LOAD = (DIST.)(LOAD) = 1956674.

ROUTE UTILIZATION = 24.

TRUCKS 21 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
DAG-INH	8.	24000.	4421.92	18.
INH-DCA	17.	24000.	.00	0.
DCA-NGU	169.	24000.	.00	0.

TOTAL DISTANCE = 194.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4656000.

ACTUAL LOAD = (DIST.)(LOAD) = 35375.

ROUTE UTILIZATION = 1.

TRUCKS 22 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-NKT	170.	24000.	10043.84	42.
NKT-NGU	170.	24000.	9072.21	38.

TOTAL DISTANCE = 340.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8160000.

ACTUAL LOAD = (DIST.)(LOAD) = 3249728.

ROUTE UTILIZATION = 40.

TRUCKS 23 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NGU-PHL	259.	24000.	9742.46	41.
PHL-PNE	10.	24000.	4115.07	17.

TOTAL DISTANCE = 269.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6456000.

ACTUAL LOAD = (DIST.)(LOAD) = 2564449.

ROUTE UTILIZATION = 40.

TRUCKS 24 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
PNE-PHL	10.	24000.	4197.26	17.
PHL-NGU	259.	24000.	9884.93	41.

TOTAL DISTANCE = 269.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6456000.

ACTUAL LOAD = (DIST.)(LOAD) = 2602170.

ROUTE UTILIZATION = 40.

Appendix M: D065 Evaluation of LOGAIR Routes

D065 Results of Current LOGAIR Route

The following represents only extracts of the actual LOGISTICS AIR LIFT COMPUTER MODEL REPORT commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 100.00 percent of total demand of 316258. pounds

unsatisfied total - 0. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
MCC-HIF	529.	35127.	29200.00	83.
HIF-TIK	884.	35127.	29528.77	84.
TIK-PFO	792.	35127.	9934.24	28.
PFO-WRB	496.	35127.	8805.48	25.

TOTAL DISTANCE = 2701.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 94878020.

ACTUAL LOAD = (DIST.)(LOAD) = 53785670.

ROUTE UTILIZATION = 57.

ROUTE 2 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-SSC	202.	35127.	16679.44	47.
SSC-LFI	316.	35127.	15983.55	46.
LFI-GSB	150.	35127.	14838.35	42.
GSB-CHS	208.	35127.	13939.73	40.
CHS-WRB	206.	35127.	13200.00	38.

TOTAL DISTANCE = 1082.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 38007420.

ACTUAL LOAD = (DIST.)(LOAD) = 16264460.

ROUTE UTILIZATION = 43.

ROUTE 3 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-SKF	917.	35127.	12312.33	35.
SKF-SBD	1143.	35127.	12641.09	36.
SBD-SUU	389.	35127.	8016.44	23.
SUU-MCC	40.	35127.	13972.60	40.

TOTAL DISTANCE = 2489.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 87431100.

ACTUAL LOAD = (DIST.)(LOAD) = 29416460.

ROUTE UTILIZATION = 34.

ROUTE 4 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-MCC	40.	35127.	.00	0.
MCC-HIF	529.	35127.	.00	0.
HIF-SKF	1106.	35127.	18076.71	51.
SKF-WRB	917.	35127.	11402.74	32.
WRB-FPO	496.	35127.	9572.60	27.

TOTAL DISTANCE = 3088.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 108472200.

ACTUAL LOAD = (DIST.)(LOAD) = 35197170.

ROUTE UTILIZATION = 32.

ROUTE 5 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FPO-DOV	461.	35127.	15950.67	45.
DOV-WRI	77.	35127.	14290.39	41.
WRI-FPO	502.	35127.	11254.79	32.

TOTAL DISTANCE = 1040.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36532080.

ACTUAL LOAD = (DIST.)(LOAD) = 14103530.

ROUTE UTILIZATION = 39.

ROUTE 6 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
PFO-TIK	792.	35127.	19797.26	56.
TIK-HIF	884.	35127.	20657.54	59.
HIF-MCC	529.	35127.	19517.80	56.
MCC-SUU	40.	35127.	9578.08	27.

TOTAL DISTANCE = 2245.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 78860110.

ACTUAL LOAD = (DIST.)(LOAD) = 44648730.

ROUTE UTILIZATION = 57.

ROUTE 7 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-SBD	564.	24549.	9731.50	40.
SBD-LSV	193.	24549.	11621.91	47.
LSV-HIF	376.	24549.	10712.33	44.

TOTAL DISTANCE = 1133.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 27814020.

ACTUAL LOAD = (DIST.)(LOAD) = 11759430.

ROUTE UTILIZATION = 42.

ROUTE 8 DC-9

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
PFO-HIF	1468.	16309.	9923.29	61.
HIF-PFO	1468.	16309.	13446.57	82.

TOTAL DISTANCE = 2936.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 47883220.

ACTUAL LOAD = (DIST.)(LOAD) = 34306950.

ROUTE UTILIZATION = 72.

ROUTE 9 DC-9

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-PSM	721.	24464.	11583.55	47.
PSM-LIZ	304.	24464.	10723.28	44.
LIZ-PBG	313.	24464.	11326.02	46.
PBG-RME	138.	24464.	10679.44	44.
RME-FFO	506.	24464.	10438.36	43.

TOTAL DISTANCE = 1982.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 48487650.

ACTUAL LOAD = (DIST.)(LOAD) = 21912230.

ROUTE UTILIZATION = 45.

ROUTE 10 C640

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-MTC	202.	11195.	3375.34	30.
MTC-OSC	131.	11195.	2745.21	25.
OSC-SAW	235.	11195.	3901.37	35.
SAW-DLH	231.	11195.	2462.37	22.
DLH-FFO	634.	11195.	2171.96	19.

TOTAL DISTANCE = 1433.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 16042440.

ACTUAL LOAD = (DIST.)(LOAD) = 3904094.

ROUTE UTILIZATION = 24.

ROUTE 10b C640

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-MTC	202.	2239.	1731.51	77.
MTC-OSC	131.	2239.	2087.67	93.
OSC-SAW	235.	2239.	1090.41	49.
SAW-FFO	481.	2239.	2239.00	100.

TOTAL DISTANCE = 1049.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 2348711.

ACTUAL LOAD = (DIST.)(LOAD) = 1956455.

ROUTE UTILIZATION = 83.

ROUTE 11 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-GFA	442.	24549.	10317.80	42.
GFA-MIB	460.	24549.	9501.35	39.
MIB-RCA	307.	24549.	8356.16	34.
RCA-FEW	224.	24549.	8180.80	33.
FEW-HIF	373.	24549.	7621.92	31.

TOTAL DISTANCE = 1806.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 44335500.

ACTUAL LOAD = (DIST.)(LOAD) = 16171910.

ROUTE UTILIZATION = 36.

ROUTE 12 DC-9

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SKP-HMN	506.	24464.	10383.55	42.
HMN-LUF	367.	24464.	9726.02	40.
LUF-DMA	129.	24464.	6915.05	28.
DMA-SKP	756.	24464.	7523.29	31.

TOTAL DISTANCE = 1758.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 43007710.

ACTUAL LOAD = (DIST.)(LOAD) = 15403170.

ROUTE UTILIZATION = 36.

ROUTE 13 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-NIP	201.	20457.	3300.77	16.
NIP-COF	152.	20457.	1761.05	9.
COF-HST	190.	20457.	4915.07	24.
HST-NQX	103.	20457.	1169.26	6.
NQX-MCF	231.	20457.	1092.55	5.
MCF-NIP	172.	20457.	922.70	5.
NIP-WRB	201.	20457.	1909.00	9.

TOTAL DISTANCE = 1250.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 25571250.

ACTUAL LOAD = (DIST.)(LOAD) = 2780223.

ROUTE UTILIZATION = 11.

ROUTE 14 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-COF	352.	4091.	4091.00	100.
COF-HST	190.	4091.	438.36	11.
HST-MCF	210.	4091.	4091.00	100.
MCF-WRB	336.	4091.	4091.00	100.

TOTAL DISTANCE = 1088.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4451008.

ACTUAL LOAD = (DIST.)(LOAD) = 3757006.

ROUTE UTILIZATION = 84.

ROUTE 14b L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-VPS	228.	24549.	8745.19	36.
VPS-SKF	727.	24549.	7331.51	30.
SKF-BAD	363.	24549.	5287.66	22.
BAD-CBM	313.	24549.	2224.63	9.
CBM-WRB	290.	24549.	1873.97	8.

TOTAL DISTANCE = 1921.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 47158630.

ACTUAL LOAD = (DIST.)(LOAD) = 10483090.

ROUTE UTILIZATION = 22.

ROUTE 15 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-TIK	814.	24549.	16153.42	66.
TIK-HIF	884.	24549.	1523.29	6.

TOTAL DISTANCE = 1698.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 41684200.

ACTUAL LOAD = (DIST.)(LOAD) = 14495470.

ROUTE UTILIZATION = 35.

ROUTE 16 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-MUO	238.	24549.	11490.40	47.
MUO-TCM	431.	24549.	11052.05	45.
TCM-SKA	229.	24549.	9435.60	38.
SKA-HIF	529.	24549.	9161.64	37.

TOTAL DISTANCE = 1427.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 35031420.

ACTUAL LOAD = (DIST.)(LOAD) = 14505410.

ROUTE UTILIZATION = 41.

ROUTE 17 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-TIK	884.	24549.	1704.11	7.
TIK-WRB	814.	24549.	23983.56	98.

TOTAL DISTANCE = 1698.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 41684200.

ACTUAL LOAD = (DIST.)(LOAD) = 21029050.

ROUTE UTILIZATION = 50.

ROUTE 18 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-SZL	312.	24549.	11030.13	45.
SZL-OFF	207.	24549.	10504.10	43.
OFF-RDR	477.	24549.	9512.32	39.
RDR-RCA	379.	24549.	8756.16	36.
RCA-IAB	544.	24549.	8876.70	36.
IAB-TIK	153.	24549.	8235.62	34.

TOTAL DISTANCE = 2072.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 50865530.

ACTUAL LOAD = (DIST.)(LOAD) = 19560680.

ROUTE UTILIZATION = 38.

ROUTE 19 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-DYS	250.	24549.	2690.39	11.
DYS-SKF	223.	24549.	1210.96	5.
SKF-FWH	243.	24549.	18991.77	77.
FWH-TIK	182.	24549.	17972.60	73.

TOTAL DISTANCE = 898.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 22045000.

ACTUAL LOAD = (DIST.)(LOAD) = 8828653.

ROUTE UTILIZATION = 40.

ROUTE 20 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-FFO	792.	24549.	8191.78	33.
FFO-BYH	418.	24549.	1446.55	6.
BYH-TIK	421.	24549.	1775.34	7.
TIK-SKF	421.	24549.	16273.97	66.
SKF-LRF	536.	24549.	4219.16	17.
LRF-TIK	299.	24549.	5309.59	22.

TOTAL DISTANCE = 2887.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 70872960.

ACTUAL LOAD = (DIST.)(LOAD) = 18540350.

ROUTE UTILIZATION = 26.

ROUTE 21 DC-9

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SKP-HIF	1106.	24464.	7901.37	32.
HIF-CVS	663.	24464.	2701.35	11.
CVS-SKP	443.	24464.	2038.36	8.

TOTAL DISTANCE = 2212.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 54114370.

ACTUAL LOAD = (DIST.)(LOAD) = 11432900.

ROUTE UTILIZATION = 21.

TRUCKS 1 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
ABQ-CVS	193.	24000.	690.41	3.
CVS-ABQ	193.	24000.	1062.99	4.

TOTAL DISTANCE = 386.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9264000.

ACTUAL LOAD = (DIST.)(LOAD) = 338407.

ROUTE UTILIZATION = 4.

TRUCKS 2 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
BAD-AEX	104.	24000.	920.52	4.
AEX-BAD	104.	24000.	536.99	2.

TOTAL DISTANCE = 208.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 4992000.

ACTUAL LOAD = (DIST.)(LOAD) = 151581.

ROUTE UTILIZATION = 3.

TRUCKS 3 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
LRF-MEM	123.	24000.	673.96	3.
MEM-LRF	123.	24000.	3589.04	15.

TOTAL DISTANCE = 246.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5904000.

ACTUAL LOAD = (DIST.)(LOAD) = 524349.

ROUTE UTILIZATION = 9.

TRUCKS 4 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
VPS-BIX	143.	24000.	1594.50	7.
BIX-VPS	143.	24000.	1424.66	6.

TOTAL DISTANCE = 286.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6864000.

ACTUAL LOAD = (DIST.)(LOAD) = 431739.

ROUTE UTILIZATION = 6.

TRUCKS 5 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
VPS-PAM	64.	24000.	2071.21	9.
PAM-VPS	64.	24000.	1879.45	8.

TOTAL DISTANCE = 128.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 3072000.

ACTUAL LOAD = (DIST.)(LOAD) = 252842.

ROUTE UTILIZATION = 8.

TRUCKS 6 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-VAD	118.	24000.	1726.01	7.
VAD-WRB	118.	24000.	1452.05	6.

TOTAL DISTANCE = 236.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5664000.

ACTUAL LOAD = (DIST.)(LOAD) = 375011.

ROUTE UTILIZATION = 7.

TRUCKS 7 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
NKO-PFO	120.	24000.	.00	0.
PFO-NKO	120.	24000.	153.42	1.

TOTAL DISTANCE = 240.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5760000.

ACTUAL LOAD = (DIST.)(LOAD) = 18411.

ROUTE UTILIZATION = 0.

TRUCKS 8 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
GUS-PFO	125.	24000.	.00	0.
PFO-GUS	125.	24000.	98.63	0.

TOTAL DISTANCE = 250.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6000000.

ACTUAL LOAD = (DIST.)(LOAD) = 12329.

ROUTE UTILIZATION = 0.

D065 Results of Author's LOGAIR Route Model

The following represents only extracts of the actual LOGISTICS AIR LIFT COMPUTER MODEL REPORT commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 98.89 percent of total demand of 316258. pounds
unsatisfied total = 3510. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-SBD	1131.	35127.	11895.89	34.
SBD-HIF	572.	35127.	6734.25	19.
HIF-TIK	875.	35127.	35127.00	100.

TOTAL DISTANCE 2578.

POTENTIAL LOAD (DIST.)(CAPACITY) 90557410.

ACTUAL LOAD (DIST.)(LOAD) 48042370.

ROUTE UTILIZATION 53.

ROUTE 2 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-HIF	875.	35127.	30549.88	87.
HIF-MCC	545.	35127.	26297.82	75.
MCC-SUU	24.	35127.	11282.18	32.

TOTAL DISTANCE 1444.

POTENTIAL LOAD (DIST.)(CAPACITY) 50723390.

ACTUAL LOAD (DIST.)(LOAD) 41334240.

ROUTE UTILIZATION 81.

ROUTE 3 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-HIF	875.	35127.	12630.13	36.
HIF-SBD	572.	35127.	9764.38	28.
SBD-TIK	1311.	35127.	9978.08	28.

TOTAL DISTANCE = 2758.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 96880260.

ACTUAL LOAD = (DIST.)(LOAD) = 29717860.

ROUTE UTILIZATION = 31.

ROUTE 4 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SUU-MCC	40.	35127.	8087.67	23.
MCC-HIF	529.	35127.	29200.00	83.
HIF-TIK	875.	35127.	23048.34	66.

TOTAL DISTANCE = 1444.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 50723390.

ACTUAL LOAD = (DIST.)(LOAD) = 35937610.

ROUTE UTILIZATION = 71.

ROUTE 5 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-SKF	420.	35127.	35127.00	100.
SKF-WRB	196.	35127.	30255.76	86.
WRB-PFO	492.	35127.	30354.40	86.
PFO-TIK	780.	35127.	35127.00	100.

TOTAL DISTANCE = 1888.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 66319780.

ACTUAL LOAD = (DIST.)(LOAD) = 63016900.

ROUTE UTILIZATION = 95.

ROUTE 6 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-FFO	780.	35127.	34073.00	97.
FFO-WRB	492.	35127.	25809.99	73.
WRB-SKF	196.	35127.	27028.37	77.
SKF-TIK	420.	35127.	35127.00	100.

TOTAL DISTANCE = 1888.

POTENTIAL LOAD = (DIST. CAPACITY) = 66319780.

ACTUAL LOAD = (DIST.)(LOAD) = 59326360.

ROUTE UTILIZATION = 89.

ROUTE 7 C640

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-MTC	213.	13434.	5106.85	38.
MTC-OSC	137.	13434.	4728.77	35.
OSC-SAW	236.	13434.	4794.52	36.
SAW-DLH	233.	13434.	4427.40	33.
DLH-FFO	632.	13434.	4131.51	31.

TOTAL DISTANCE = 1451.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19492730.

ACTUAL LOAD = (DIST.)(LOAD) = 6509806.

ROUTE UTILIZATION = 33.

ROUTE 8 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-RME	520.	35127.	11654.78	33.
RME-PBG	130.	35127.	11046.56	31.
PBG-LIZ	316.	35127.	10142.45	29.
LIZ-PSM	283.	35127.	10619.16	30.
PSM-FFO	743.	35127.	9731.51	28.

TOTAL DISTANCE = 1992.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 69972980.

ACTUAL LOAD = (DIST.)(LOAD) = 20937280.

ROUTE UTILIZATION = 30.

ROUTE 9 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-WRI	515.	35127.	19956.15	57.
WRI-DOV	81.	35127.	16827.38	48.
DOV-LFI	149.	35127.	15156.15	43.
LFI-FFO	455.	35127.	14000.00	40.

TOTAL DISTANCE = 1200.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 42152400.

ACTUAL LOAD = (DIST.)(LOAD) = 20268700.

ROUTE UTILIZATION = 48.

ROUTE 10 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-MUO	243.	25549.	11117.80	44.
MUO-TCM	432.	25549.	10684.92	42.
TCM-SKA	230.	25549.	9287.66	36.
SKA-HIF	520.	25549.	9161.64	36.

TOTAL DISTANCE = 1425.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36407320.

ACTUAL LOAD = (DIST.)(LOAD) = 14217730.

ROUTE UTILIZATION = 39.

ROUTE 11 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIP-GPA	430.	34549.	14087.65	41.
GPA-MIB	463.	34549.	13304.11	39.
MIB-RDR	189.	34549.	12306.84	36.
RDR-RCA	369.	34549.	11742.46	34.
RCA-FEW	221.	34549.	12027.39	35.
FEW-HIF	367.	34549.	11583.56	34.

TOTAL DISTANCE = 2039.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 70445410.

ACTUAL LOAD = (DIST.)(LOAD) = 25785670.

ROUTE UTILIZATION = 37.

ROUTE 12 C640

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SBD-DMA	405.	13434.	9167.13	68.
DMA-LUP	130.	13434.	9852.06	73.
LUP-LSV	251.	13434.	7320.55	54.
LSV-SBD	187.	13434.	6849.32	51.

TOTAL DISTANCE = 973.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 13071280.

ACTUAL LOAD = (DIST.)(LOAD) = 8111734.

ROUTE UTILIZATION = 62.

ROUTE 13 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-OFF	412.	24549.	10054.79	41.
OFF-SZL	216.	24549.	9063.00	37.
SZL-IAB	221.	24549.	8536.96	35.
IAB-LRF	343.	24549.	7895.87	32.
LRF-TIK	295.	24549.	6104.11	25.

TOTAL DISTANCE = 1487.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36504360.

ACTUAL LOAD = (DIST.)(LOAD) = 12495850.

ROUTE UTILIZATION = 34.

ROUTE 14 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-BYH	419.	24549.	11676.71	48.
BYH-CBM	168.	24549.	14115.07	57.
CBM-BIX	217.	24549.	13731.50	56.
BIX-VPS	133.	24549.	13539.73	55.
VPS-WRB	227.	24549.	12219.18	50.

TOTAL DISTANCE = 1164.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 28575040.

ACTUAL LOAD = (DIST.)(LOAD) = 14818150.

ROUTE UTILIZATION = 52.

ROUTE 15 L188

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-SSC	196.	24549.	13008.21	53.
SSC-GSB	190.	24549.	11985.50	49.
GSB-CHS	231.	24549.	11021.11	45.
CHS-WRB	194.	24549.	10204.68	42.

TOTAL DISTANCE = 811.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19909240.

ACTUAL LOAD = (DIST.)(LOAD) = 9352438.

ROUTE UTILIZATION = 47.

ROUTE 16 L100

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-NIP	193.	35127.	7391.78	21.
NIP-COF	152.	35127.	5852.04	17.
COF-HST	197.	35127.	5139.71	15.
HST-NQX	99.	35127.	4805.47	14.
NQX-MCF	226.	35127.	4728.76	13.
MCF-NIP	190.	35127.	4432.88	13.
NIP-WRB	193.	35127.	5397.26	15.

TOTAL DISTANCE = 1250.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 43908750.

ACTUAL LOAD = (DIST.)(LOAD) = 6757005.

ROUTE UTILIZATION = 15.

TRUCKS 1 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
PFO-NKO	123.	24000.	153.42	1.
NKO-PFO	123.	24000.	.00	0.

TOTAL DISTANCE = 246.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5904000.

ACTUAL LOAD = (DIST.)(LOAD) = 18871.

ROUTE UTILIZATION = 0.

TRUCKS 2 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FFO-GUS	151.	24000.	98.63	0.
GUS-FFO	151.	24000.	.00	0.

TOTAL DISTANCE = 302.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 7248000.

ACTUAL LOAD = (DIST.)(LOAD) = 14893.

ROUTE UTILIZATION = 0.

TRUCKS 3 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HIF-ABQ	606.	24000.	920.53	4.

TOTAL DISTANCE = 606.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 14544000.

ACTUAL LOAD = (DIST.)(LOAD) = 557842.

ROUTE UTILIZATION = 4.

TRUCKS 4 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
ABQ-HIF	606.	24000.	690.41	3.

TOTAL DISTANCE = 606.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 14544000.

ACTUAL LOAD = (DIST.)(LOAD) = 418389.

ROUTE UTILIZATION = 3.

TRUCKS 5 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SKF-HMN	611.	24000.	3550.67	15.

TOTAL DISTANCE = 611.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 14664000.

ACTUAL LOAD = (DIST.)(LOAD) = 2169458.

ROUTE UTILIZATION = 15.

TRUCKS 6 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
HMN-SKF	611.	24000.	2772.60	12.

TOTAL DISTANCE = 611.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 14664000.

ACTUAL LOAD = (DIST.)(LOAD) = 1694061.

ROUTE UTILIZATION = 12.

TRUCKS 7 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SKF-DYS	263.	24000.	2690.39	11.

TOTAL DISTANCE = 263.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6312000.

ACTUAL LOAD = (DIST.)(LOAD) = 707573.

ROUTE UTILIZATION = 11.

TRUCKS 8 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
DYS-SKF	263.	24000.	1035.62	4.

TOTAL DISTANCE = 263.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6312000.

ACTUAL LOAD = (DIST.)(LOAD) = 272367.

ROUTE UTILIZATION = 4.

TRUCKS 9 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
AEX-SKF	461.	24000.	520.55	2.

TOTAL DISTANCE = 461.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 11064000.

ACTUAL LOAD = (DIST.)(LOAD) = 239973.

ROUTE UTILIZATION = 2.

TRUCKS 10 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
SKF-AEX	461.	24000.	920.52	4.

TOTAL DISTANCE = 461.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 11064000.

ACTUAL LOAD = (DIST.)(LOAD) = 424361.

ROUTE UTILIZATION = 4.

TRUCKS 11 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-CVS	414.	24000.	1643.82	7.

TOTAL DISTANCE = 414.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9936000.

ACTUAL LOAD = (DIST.)(LOAD) = 680540.

ROUTE UTILIZATION = 7.

TRUCKS 12 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
CVS-TIK	414.	24000.	1353.42	6.

TOTAL DISTANCE = 414.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9936000.

ACTUAL LOAD = (DIST.)(LOAD) = 560317.

ROUTE UTILIZATION = 6.

TRUCKS 13 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-FWH	231.	24000.	3758.89	16.

TOTAL DISTANCE = 231.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5544000.

ACTUAL LOAD = (DIST.)(LOAD) = 868303.

ROUTE UTILIZATION = 16.

TRUCKS 14 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
FWH-TIK	231.	24000.	2739.73	11.

TOTAL DISTANCE = 231.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5544000.

ACTUAL LOAD = (DIST.)(LOAD) = 632877.

ROUTE UTILIZATION = 11.

TRUCKS 15 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
TIK-BAD	359.	24000.	3353.40	14.

TOTAL DISTANCE = 359.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8616000.

ACTUAL LOAD = (DIST.)(LOAD) = 1203872.

ROUTE UTILIZATION = 14.

TRUCKS 16 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
BAD-TIK	359.	24000.	673.97	3.

TOTAL DISTANCE = 359.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 8616000.

ACTUAL LOAD = (DIST.)(LOAD) = 241956.

ROUTE UTILIZATION = 3.

TRUCKS 17 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
WRB-VAD	150.	24000.	1726.01	7.
VAD-WRB	150.	24000.	1435.62	6.

TOTAL DISTANCE = 300.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 7200000.

ACTUAL LOAD = (DIST.)(LOAD) = 474243.

ROUTE UTILIZATION = 7.

TRUCKS 18 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
BYH-MEM	46.	24000.	673.96	3.
MEM-BYH	46.	24000.	2953.42	12.

TOTAL DISTANCE = 92.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 2208000.

ACTUAL LOAD = (DIST.)(LOAD) = 166859.

ROUTE UTILIZATION = 8.

TRUCKS 19 MACK

LEG	DISTANCE(MILES)	CAPACITY(LBS)	LOAD(LBS)	UTILIZATION
VPS-PAM	72.	24000.	2071.21	9.
PAM-VPS	72.	24000.	1863.01	8.

TOTAL DISTANCE = 144.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 3456000.

ACTUAL LOAD = (DIST.)(LOAD) = 283264.

ROUTE UTILIZATION = 8.

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Vita

Captain Thomas James Bruns [REDACTED]

[REDACTED] graduated from high school in Huber Heights, Ohio in 1973 and attended Wright State University from which he received a Bachelor of Science in Biology and Environmental Health in 1978. Consequently, he worked as an Environmental Consultant for Howard Laboratories located in Kettering, Ohio. In March 1980, he received a commission, through OTS, in the United States Air Force and completed Transportation Officer School in July 1980. After completion of school, Bruns was assigned to the Electronics System Division at Hanscom AFB, Massachusetts where he served as an Acquisition Transportation Officer. In October of 1982, he was reassigned to the 21st Tactical Fighter Wing Elmendorf AFB, Alaska, as the Vehicle Maintenance Officer. In Alaska, he gained experience in mobility, budgeting, and maintenance operations. In July 1986, he was assigned to Headquarter, Air Force Logistics Command Wright-Patterson AFB, Ohio, as a Plans and Programs Officer for Directorate of Distribution. This position provided experience in war planning and mobility training. Finally, in May 1989, Capt Bruns entered the School of Systems and Logistics, Air Force Institute of Technology.

Capt Bruns is married to the former Angela Lynn Smithson of Huber Heights, Ohio. Their children are Meghan (24 Jun 84) and Laura (18 Dec 86).

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